SECTION 15021--HIGH DENSITY POLYETHYLENE (HDPE) PIPE

PART 1--GENERAL

REFERENCES:

The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
ASTM D1248	Specification for Polyethylene Plastics Molding and Extrusion Materials.
ASTM D1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D2513	Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
ASTM D2657	Practice for Heat Joining of Polyolefin Pipe and Fittings.
ASTM D2683	Specification for Socket-Type Polyethylene Fittings for Outside-Diameter Controlled Polyethylene Pipe and Tubing.
ASTM D3083	Standard Specification for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining.
ASTM D3350	Specification for Polyethylene Plastics Pipe and Fitting Materials.
ASTM F714	Standard Specification for Polyethylene Plastic Pipe (SDR-PR) Based on Outside Diameter.

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 192.285	Plastic pipe; qualifying persons to make joints.

DESCRIPTION:

Pipe: This section includes all high density polyethylene (HDPE) pipe used in the ICDF landfill and evaporation pond including but not limited to:

Leachate collection piping on floor and cleanout access pipes on the slopes of the trench.

Leachate discharge piping, leak detection piping, and associated riser pipes.

Double containment piping outside the landfill (e.g., leachate force main and drain lines) and elsewhere as shown on the Drawings.

PART 2--PRODUCTS

HDPE MATERIALS:

All HDPE pipe shall meet the following requirements:

Specific Gravity: As determined by ASTM D792 or D1505, 0.94 minimum.

Carbon Black Content: As determined by ASTM D1603, 2.0 percent minimum.

Resistance to Soil Burial: As determined by ASTM D3083, as modified by NSF Standard 54 Appendix A, Part 3. At least 90 percent strength retained.

Melt Index: As determined by ASTM D1238 Condition 190.2.16, 0.1 to 1.1 g per 10 min.

All HDPE pipe and fittings shall conform with additional requirements defined in the Piping Schedule in Section 15060, PIPING-GENERAL.

HDPE PIPE:

Resin: HDPE pipe shall be manufactured from first quality polyethylene resin containing no more than 2 percent clean recycled polymer by weight. Resin shall be Type III, Category 5, Class C, Grade 34 per ASTM D1248. The cell classification shall be 345434C per ASTM D3350. Pipe shall be rated PE3408. Pipe and fittings shall be in compliance with schedule attached as supplement (see Attachment 1, HIGH DENSITY POLYETHYLENE (HDPE) PIPE) or as shown on the Drawings.

Quality: The pipe shall have uniform wall thickness and shall be uniform in color, opacity, density, and other physical properties. Pipe shall be homogeneous throughout and free of visible cracks, holes, blisters, bubbles, undispersed raw materials, or any contamination by foreign matter. Any pipe with nicks, scrapes, or gouges deeper than 10 percent of the nominal wall thickness shall be rejected.

Form: Pipe may be supplied in a continuous extruded seamless piece or in sections.

Manufacturer's QC Certificates: Prior to shipment, the HDPE pipe manufacturer shall submit a quality control certificate for each lot/batch of HDPE pipe provided. The quality control certificate shall be signed by a responsible party employed by the HDPE pipe manufacturer, such as the Production Manager. The quality control certificate shall include both:

Lot/batch numbers and identification.

Sampling procedures and results of quality control tests.

All HDPE pipe shall be SDR 17 unless indicated otherwise on the Drawings.

Fittings: Fittings shall conform to the requirements of Articles HDPE MATERIALS and HDPE PIPE of this section and shall be compatible with the other components of the double containment system.

DOUBLE CONTAINMENT PIPE:

Pipe Materials: Both carrier pipe and containment pipe shall meet the requirements of Articles HDPE MATERIALS and HDPE PIPE, of this section.

Configuration: Double containment pipe shall consist of a carrier pipe installed within a containment pipe. All pipe and fittings shall provide an annular space between the carrier and containment pipes to accommodate possible flow of fluid from the carrier pipe.

Support Spacers: Support spacers, if used, shall be manufactured from non-metallic, corrosion resistant material. Spacers shall be secured to the carrier pipe at nominal 8-foot intervals. The spacers shall maintain the annulus between the carrier and containment pipes and shall be positioned to allow for unrestricted passage of possible flow of fluid from the carrier pipe. Spacers shall be chamfered at both ends to allow for removal of carrier pipe.

Fittings: Fittings shall conform to the requirements of Articles HDPE MATERIALS and HDPE PIPE of this section and shall be compatible with the other components of the double containment system.

COUPLINGS AND END CAPS:

Couplings: Couplings for socket fusion shall satisfy the Specifications listed above for HDPE pipe, except that other cell classifications are acceptable provided that they are compatible with the HDPE pipe and provide equivalent performance to class 345434C. Couplings shall satisfy the requirements of ASTM D2513 and shall be manufactured in compliance with ASTM D2683.

Flanged Connections: Where pipes or fittings of different materials are connected, the coupling shall be a flanged connection as defined on the pipe data sheet supplement. Gaskets shall be required when joining to nonpolyethylene materials.

SLOTTED PIPE:

Leachate Collection Piping: Leachate collection and leak detection piping on the floor of the landfill and elsewhere as shown on the Drawings shall be slotted. Cleanout access pipes and leachate transmission piping shall not be slotted.

In addition to meeting all other requirements of this section, slotted pipe shall have slots 0.2 inch wide and 2 inches long, in four places equidistant around the pipe. Slots shall provide a minimum of 8 square inches of open area per linear foot of pipe. Slotted pipes shall be free of cutting debris from the slot cutting process.

PART 3--EXECUTION

GENERAL:

All HDPE pipe and fittings shall be installed in conformance with applicable code requirements referenced in the Piping Schedule, Section 15060, PIPING-GENERAL.

DIMENSIONS:

Piping dimensions shown on the Drawings are approximate. It is the Construction Subcontractor's responsibility to furnish and install piping of the proper dimensions, which will properly fit with the connecting elements, pipes, fittings, pumps, etc.

INSTALLATION:

Pipe shall be handled and stored in such a manner as to ensure a sound, undamaged condition.

Pipe shall be cut in a neat, workmanlike manner using an approved mechanical cutter that will not damage the pipe.

Joining of HDPE pipe to HDPE pipe shall be accomplished by thermal butt fusion joint; no solvent welding, adhesive welding, or electrofusion couplings shall be allowed. Slotted leachate collection piping shall be joined with thermal butt fusion joints. Pipe shall be joined per ASTM D2657 and manufacturer's recommendations. Installation personnel who join HDPE pipe shall be experienced and certified in accordance with 49 CFR 192.285.

Single butt fusion welds shall be used to create pipe sections as long as practicable or as specified in the Construction Subcontractor's procedure. Fabricated pipe sections and fittings may be joined by the double butt fusion process.

During installation, the pipe shall not be pulled across sharp projections that could cause gouges, kinks, or other types of damage. To minimize "snaking" due to thermal expansion, protect pipe from direct sunlight, or limit unrestrained length of pipe during installation.

Placement of Buried Pipes:

Excavate trench bottom and sides of ample dimensions to permit visual inspection and testing of entire flange, valve, or connection.

The pipe shall not be dropped into the trench. Exercise care when lowering pipe into trench to prevent twisting or damage to pipe. The full length of the pipe shall be firmly bedded on the trench bottom.

The pipe shall be bedded in such a way as to maintain grade with a tolerance of -0.0 percent, +0.5 percent. Measure for grade at pipe invert, not at top of pipe.

Pipe Base and Pipe Zone: As specified in Section 02320, TRENCH BACKFILL.

Keep trench dry until pipe laying and joining are completed.

Prevent foreign material from entering pipe during placement.

Close and block open end of last laid pipe section when placement operations are not in progress and at close of day's work.

Install closure sections and adapters for gravity piping at locations where pipe laying changes direction.

After joint has been made, check pipe alignment and grade.

Place sufficient pipe zone material to secure pipe from movement before next joint is installed.

Prevent uplift and floating of pipe prior to backfilling.

Place pipe along pipe runs starting at one end and moving towards the other to avoid joints that will not be feasible with butt fusion.

Tolerances:

Horizontal position of pipe centerline on alignment around curves maximum variation of 1.75 feet from position shown.

Pipe Cover: Minimum 5 feet, unless otherwise shown.

Temporarily close pipe ends as required to avoid introducing dirt or other foreign material into the pipe.

Trenching and backfilling operations shall be conducted in accordance with the requirements of Section 02320, TRENCH BACKFILL for utility trenching. If trenching is used, underlying materials shall not be disturbed or damaged in anyway. Backfilling operations shall ensure that no voids are present under or at the sides of the pipe. Backfill shall initially

be placed to the top of the pipe, then hand compacted. The remainder of the trench shall then be backfilled and compacted by hand or with a power tamper only.

On the floor of the landfill, pipe may be placed directly on geosynthetic layers prior to placing drainage gravel. Placement of gravel around pipes shall be by hand unless otherwise approved by the BBWI Construction Manager. Placement operations shall ensure that no voids are present under or at the sides of the pipe. Placement operations shall not disturb the position of the pipe.

Where flanged joints are used, the bolts shall be evenly torqued using a crossing pattern to gradually tighten the lug nuts. Torque values shall be as recommended by the flange manufacturer. Flanged joints shall be retorqued after one hour or more has passed. Apply anti-sieze compound on all stainless steel bolts before tightening.

Flaws (minor imperfections, damaged areas, etc.) in HDPE pipe with a depth of 10 percent or less of the nominal wall thickness will not require repair or replacement. In double containment systems, carrier pipe with flaws deeper than 10 percent of the wall thickness shall be replaced. Single pipe or containment pipe with flaws between 10 and 25 percent of the wall thickness shall be repaired in accordance with the pipe manufacturer's recommendations. The Construction Subcontractor shall certify in writing that the repaired area will have material properties that meet or exceed those of intact pipe. Any pipe with flaws deeper than 25 percent of the nominal wall thickness shall be rejected.

All valves and equipment shall be supported independently from pipe. Anchor valves such that turning moment resulting from their operation will not be transmitted to pipe.

> Special Precautions at Flanges: Polyethylene pipe connected to heavy fittings, manholes, and rigid structures shall be supported in such a manner that no subsequent relative movement between polyethylene pipe at flanged joint and rigid structures is possible.

Butt-fusion shall be performed in accordance with pipe manufacturer's recommendations as to equipment and technique.

Slotted Pipe: Remove internal weld beads from the horizontal sections of slotted pipe where the LCRS and LDRS pumps will be placed.

LOCATOR RIBBON:

Locator ribbon shall be installed as specified in Section 02320, TRENCH BACKFILL.

IDENTIFICATION RIBBON:

Underground pipelines shall be identified by use of a plastic ribbon or stencil no less than 3 inches in width with a message printed on the ribbon which identifies the actual pipeline

contents. Marking tapes or stencils shall be placed on existing lines where they are exposed by trenching operations. The ribbon shall be wrapped around the pipeline at no less than 1 wrap per 3 feet of run. The plastic ribbon/stencil shall be color coded in accordance with the Piping Schedule and INEEL Guide Specifications.

CLEANING:

Clean all piping as required in Section 15060, PIPING-GENERAL to remove all foreign materials including dirt, grease, and other matter.

ACCEPTANCE TESTING:

Per Section 15992, PIPING LEAKAGE TESTING, and the Piping Schedule in Section 15060, PIPING-GENERAL.

END OF SECTION 15021

ATTACHMENT 1
HIGH DENSITY POLYETHYLENE (HDPE) PIPE

Item	Size	Description
General	All	Pipe lengths, fittings, and flanged connections to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.
Pipe		Pipe shall be SDR* 17 unless otherwise noted. Protection shall be provided against ultraviolet light degradation using carbon black, not less than 2 percent well dispersed in the resin. Pipe wall thickness shall reflect the required SDR* and diameter, as shown in Table 8, ASTM F714. Pressure rating shall be 100 psi minimum. *SDR: standard dimension ratio = OD/thickness
Fittings	6-inch and smaller	Molded fittings, butt fusion joined, conforming to ASTM D3261.
	8-inch and larger	Same as pipe, butt fusion joined, conforming to ASTM D3350. All fittings shall have same pressure rating as pipe, unless otherwise noted.
Flanges		ASTM A240 Type 304 stainless steel, 125-pound, ANSI B16.1 standard, Van Stone type with one-piece molded polyethylene stud ends, same rating as pipe.
Bolting		Stainless steel, ASTM A193/A193M Grade B8M studs and ASTM A194/A194M Grade 8M hex head nuts. Washers shall be same material as bolts.
Gaskets		Flat ring, 1/8-inch ethylene propylene rubber (EPR).

SECTION 15022--HIGH DENSITY POLYETHYLENE MANHOLES

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D1248	Specification for Polyethylene Plastics Molding and Extrusion Materials.
ASTM D3350	Specification for Polyethylene Plastics Pipe and Fitting Materials.

PART 2--PRODUCTS

HDPE MANHOLES:

The manhole shall be manufactured by the fabrication of high density polyethylene (HDPE pipe). The riser shall be made of HDPE plastic compound meeting the requirements of Type III, Class C, Category 5, Grade P34 as defined in ASTM D1248. The cell classification shall be 345444C per ASTM D3350. Pipe shall be rated PE3408.

Flatstock shall meet or exceed ASTM D1248 requirements for Type III, Class A, B or C, Category 3, Grade G5. Flatstock shall be manufactured from first quality polyethylene resin containing no more than 2 percent clean recycled polymer by weight.

HDPE pipe and flatstock used to fabricate the HDPE manhole shall meet all product requirements of Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE. HDPE pipe shall be minimum SDR 32.5. Manhole dimensions as shown.

Welding rods, connecting couplings, pipe collars and other materials, as required to complete the installation, shall be of the same plastic as the flatstock, and supplied by the same manufacturer.

Piping, valves and appurtenances shall meet the requirements of Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE, Section 15060, PIPING–GENERAL, and Section 15100, VALVES AND OPERATORS.

An access cover shall be provided for each manhole. Cover shall be 48-inch diameter HDPE lid (minimum 1-1/2 inches thick) bolted to 48-inch diameter flanged HDPE section. Bolts shall be stainless steel penta head. Attach aluminum or galvanized steel angle stiffeners on the underside to prevent lid from sagging.

PART 3--EXECUTION

FABRICATION:

Inlet and outlet piping shall be installed as shown on Drawings by fabricator prior to delivery to site.

The manhole shall be fabricated with the minimum number of welds practical.

All welds shall be heat fused in accordance with ASTM D2657 on equipment specifically designed for welding thermoplastic sheets or extrusion welded by precertified welders.

INSTALLATION:

Manholes shall be handled and stored according to manufacturer's recommendations and in such a manner as to ensure a sound undamaged condition.

Excavation and backfilling operations shall be conducted in accordance with Section 02316, EXCAVATION, and Section 02315, FILL AND BACKFILL.

Joining of HDPE to HDPE shall be done by thermal butt or socket fusion, no solvent or adhesive welding shall be allowed. HDPE welding shall be qualified and approved welders.

Install piping, valves and appurtenances, and pipe hangers and supports in accordance with Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE, Section 15060, PIPING-GENERAL, and Section 15100, VALVES AND OPERATORS.

Install frame and access cover in accordance with manufacturer's instructions.

END OF SECTION

SECTION 15060--PIPING-GENERAL

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B1.20.1	Pipe Threads, General Purpose (Inch).
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings.
ANSI B16.3	Malleable Iron Threaded Fittings.
ANSI B16.5	Pipe Flanges and Flanged Fittings.
ANSI B16.11	Forged Fittings, Socket-Welding and Threaded.
ANSI B16.21	Nonmetallic Flat Gaskets for Pipe Flanges.
ANSI B16.42	Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.3	Chemical Plant and Petroleum Refinery Piping.
ASME B36.10M	Welded and Seamless Wrought Steel Pipe.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
ASTM A536	Standard Specification for Ductile Iron Castings.
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts.
ASTM D1248	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
ASTM D1785	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
ASTM D2467	Standard Specification for Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

ASTM D2564	Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C153/ A21.53	Ductile-Iron Compact Fittings 3 Inches Through 24 Inches and 54 Inches Through 64 Inches, for Water Service.

DEPARTMENT OF ENERGY (DOE)

DOE-ID Architectural Engineering Standards:
1540, Piping – General Requirements.
Appendix M, Piping Materials, Pipe Numbering, Labeling and Color Coding.

SEQUENCING AND SCHEDULING:

Commence disinfection after completion of following: Hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.

PART 2--PRODUCTS

PIPING:

High Density Polyethylene Piping: As specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

FIRE PROTECTION PIPING:

As specified in Section 15505, UNDERGROUND FIRE PROTECTION PIPING.

RAW WATER PIPING:

As specified herein and in Section 15505, UNDERGROUND FIRE PROTECTION PIPING, as applicable.

Others as specified on Piping Data Sheet(s) and Piping Schedule located at the end of this section as Supplement.

Diameters Shown:

Standardized Products: Nominal size.

Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.

JOINTS:

Flanged Joints:

Flat-faced carbon steel or alloy flanges when mating with flat-faced cast or ductile iron flanges.

Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

Threaded Joints: NPT taper pipe threads in accordance with ANSI B1.20.1.

Thrust Tie-Rod Assemblies: NFPA 24; tie-rod attachments relying on clamp friction with pipe barrel to restrain thrust are unacceptable.

Mechanical Joint Anchor Gland Follower:

Ductile iron anchor type, wedge action, with breakoff tightening bolts.

Manufacturer and Product: EBAA Iron Inc.; Megalug.

Flexible Mechanical Compression Joint Coupling:

Stainless steel, ASTM A276, Type 305 bands.

Manufacturers:

Pipeline Products Corp.

Fernco Joint Sealer Co.

Mechanical connections of high density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through flanged connections consisting of the following:

A polyethylene stub end thermally butt-fused to end of pipe.

ASTM A240, Type 304 stainless steel backing flange, 125-pound, ANSI B16.1 standard. Insulating flanges shall be used where shown.

Bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to manufacturer's standard. Retorque nuts after 4 hours.

Gaskets as specified on Data Sheet.

GASKET LUBRICANT:

Lubricant shall be supplied by pipe manufacturer and no substitute or "or-equal" will be allowed.

DOUBLE WALL CONTAINMENT PIPING SYSTEM:

As specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

THRUST BLOCKS:

Concrete: As specified in Section 03301, CONCRETE.

VENT AND DRAIN VALVES:

Pipeline 2-Inch Diameter and Smaller: 1/2-inch vent, 1-inch drain, unless shown otherwise.

Pipelines 2-1/2-Inch Diameter and Larger: 3/4-inch vent, 1-inch drain, unless shown otherwise.

WATER HOSE:

Furnish six 50-foot length(s) of 1-1/2-inch., EPDM black cover and EPDM tube, reinforced with two textile braids. Furnish each length with brass male and female NST hose thread couplings to fit hose nozzle(s) and hose valve(s) specified.

Rated minimum working pressure of 200 psi.

Manufacturers:

Goodyear.

Boston.

FABRICATION:

Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.

FINISHES:

Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s) and Piping Schedule.

Galvanizing:

Hot-dip applied, meeting requirements of ASTM A153.

Electroplated zinc or cadmium plating is unacceptable.

Stainless steel components may be substituted where galvanizing is specified.

LOCATOR RIBBON:

As specified in Section 02320, TRENCH BACKFILL.

INSULATION:

Piping:

Riser Pipes:

Rigid fiberglass insulation wrapped with factory-applied, kraft reinforced vapor barrier jacket with pressure-sensitive, self-sealing lap, UL rated, 1-1/2 inches thick.

Circumferential Joints: Matching pressure-sensitive butt strips.

Manufacturers and Products:

Owens-Corning; Fiberglass ASJ/SSL-11.

Manville; Micro-Lok 650 with AP-T jacket.

Combined Sump (Riser Pipes Only):

Material: Flexible elastomeric pipe insulation, closed cell structure, 3/4 inch thick.

Temperature Rating: Minus 40 degrees F to 180 degrees F.

Nominal Density: 6 pcf.

Conductivity in accordance with ASHRAE 90.1 and minimum of 0.27 BTU-in/hr-ft^2 degrees F at 75 degrees F per ASTM C177 or ASTM C518.

Minimum water vapor transmission of 0.10 perm-inch per ASTM E96.

Seal joints with manufacturer's adhesive.

Flame Spread Rating: Less than 25 per ASTM E84.

Manufacturers and Products:

Rubatex; R-180-FS.

Armstrong; Armaflex AP.

Piping and Insulation Cover: Aluminum jacket 0.016-inch thick.

PART 3--EXECUTION

EXAMINATION:

Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

PREPARATION:

Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

INSTALLATION-GENERAL:

Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

Remove foreign objects prior to assembly and installation.

Flanged Joints:

Install perpendicular to pipe centerline.

Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.

Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.

Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.

Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.

Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.

Threaded flanged joints must be shop fabricated and delivered to jobsite with flanges in-place and properly faced.

Threaded and Coupled Joints:

Conform with ANSI B1.20.1.

Produce sufficient thread length to ensure full engagement when screwed home in fittings.

Countersink pipe ends, ream and clean chips and burrs after threading.

Make connections with not more than three threads exposed.

Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

High Density Polyethylene Piping: As specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

INSTALLATION-EXPOSED PIPING:

Piping Runs:

Parallel to building or column lines and perpendicular to floor, unless shown otherwise.

Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

Piping Clearance (unless otherwise shown):

Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet 0 inches, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

From Adjacent Work: Minimum 1 inch from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.

Head room in front of openings, doors, and windows shall not be less than the top of the opening.

Do not install piping containing liquids or liquid vapors in transformer vaults.

Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

INSTALLATION-DOUBLE WALL CONTAINMENT PIPING SYSTEM:

Install as specified in Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

INSTALLATION-BURIED PIPE:

Placement: In accordance with Section 15021, HIGH DENSITY POLYETHYLENE (HDPE) PIPE.

INSTALLATION-BURIED GASKETED PIPE:

Install fire protection piping and gasketed raw water piping in accordance with Section 15505, UNDERGROUND FIRE PROTECTION PIPING.

THRUST RESTRAINT:

Location: At pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist.

Type: Thrust blocks. Use joint restraint where shown, or otherwise required or approved.

Thrust Blocking:

Install in accordance with Section 15505, UNDERGROUND FIRE PROTECTION PIPING, and as detailed on the Drawings.

Place blocking so that pipe and fitting joints will be accessible for repairs.

Place concrete in accordance with Section 03301, CONCRETE.

SLAB, FLOOR, WALL, AND ROOF PENETRATIONS:

Application and Installation: As shown on Drawings.

Wall Pipe Installation: Support wall pipes securely by framework to prevent contact with reinforcing steel and tie wires.

BRANCH CONNECTIONS:

Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including the first block valve in the line carrying the lower pressure, unless otherwise shown.

Threaded Pipe Tap Connections:

Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.

Limitations: Threaded taps in pipe barrel are unacceptable.

VENTS AND DRAINS:

Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines at all low and high point locations. VENTS AND DRAINS ARE NOT SHOWN ON DRAWINGS.

CLEANING:

Following assembly and testing, and prior to final acceptance, flush pipelines (except as stated below) with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

If impractical to flush large diameter pipe at 2.5 fps, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.

Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

FIELD FINISHING:

Notify BBWI Construction Manager at least 3 days prior to start of any surface preparation or coating application work.

LOCATOR RIBBON:

Locator ribbon shall be installed as specified in Section 02320, TRENCH BACKFILL.

PIPE IDENTIFICATION:

Buried Piping:

Identification Ribbon: Underground pipelines shall be identified by use of a plastic ribbon or stencil no less than 3 inches in width with a message printed on the ribbon which identifies the actual pipeline contents. Marking tapes or stencils shall be placed on existing lines where they are exposed by trenching operations. The ribbon shall be wrapped around the pipeline at no less than 1 wrap per 3 feet of run. The plastic ribbon/stencil shall be color coded in accordance with the Piping Schedule and INEEL Guide Specifications.

Exposed Piping:

In general, all exposed piping shall be color coded and identified in accordance with ANSI A-13-1. It is the intent of this standard that the identification method of aboveground piping is by English text that allows the contents to be readily identified. Flow direction should be also shown by arrows.

All piping and equipment shall be identified in accordance with established site standards. Piping identification legends and symbols shall conform to the appropriate drawing listed in Appendix D of the AE Standards.

In addition to the requirements specified herein, all pipelines and standard equipment shall be color coded and identified according to Appendix M of the AE Standards and shall be tagged with beaded chain or steel cable stainless steel tags displaying the pipe or equipment number as shown on the drawings. The tags shall be fabricated from 300 series austenitic stainless steel metal strips 3/4 inches wide, 24-gauge minimum thickness, with 3/16-inch high letters stamped on the metal surface. Tagging for pipe shall be done at approximately 20-foot intervals with at least one tag in each room. Any pipes entering or leaving a room shall be tagged on each side of the wall. The tags shall be attached to the pipe or austenitic equipment with austenitic stainless steel bead chain or austenitic stainless steel cable. When tagging valves, the bead chain shall be attached to the valve stem or yoke.

LEAKAGE TESTING:

As specified in Section 15992, PIPING LEAKAGE TESTING.

SUPPLEMENTS:

Supplement 1—Polyvinyl Chloride (PVC) Pipe and Fittings.

Supplement 2—Galvanized Steel Pipe and Malleable Iron Fittings.

Supplement 3—Piping Schedule.

END OF SECTION 15060

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

Item	Size	Description
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with 2 percent titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket-weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with 2 percent titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket-weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One piece, molded hub type PVC flat face flange in accordance with Fittings above, 125-pound ANSI B16.1 drilling
Bolting	All	ASTM A193/A193M Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/ A194M Grade 8M hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch thick ethylene propylene (EPR) rubber. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564.
Thread Lubricant	All	Teflon Tape.

GALVANIZED STEEL PIPE AND MALLEABLE IRON FITTINGS

Item	Size	Description
Pipe		Galvanized carbon steel, ASTM A106, Grade B seamless or ASTM A53, Grade B seamless or ERW.
	2" and smaller	Schedule 80.
	2-1/2" through 6"	Schedule 40.
Joints	All	Threaded or flanged at valves and equipment.
Fittings		Threaded: 150- or 300-pound galvanized malleable iron, ASTM A197 or ASTM A47, dimensions in accordance with ANSI B16.3.
Flanges		Galvanized forged carbon steel, ASTM A105/A105M, ANSI B16.5 Class 150 or Class 300, threaded, 1/16-inch raised face.
Unions		Threaded malleable iron, ASTM A197 or A47, 300-pound WOG, brass to iron seat, meeting the requirements of ANSI B16.3.
Bolting		Flanges: Carbon steel ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts.
Gaskets	All flanges	Flanged, Water and Sewage Service: 1/8 inch thick, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F, conforming to ANSI B16.21, AWWA C207, and ASTM D1330, Grades 1 and 2.
Thread Lubricant	2" & smaller	Teflon tape or joint compound that is insoluble in water.

PIPING SCHEDULE LEGEND

SERVICE

FW	Fire Protection Water
RW	Raw Water
LCRS	Leachate Collection Recovery System
LDRS	Leak Detection Recovery System
D	Drain
SPD	Sump Pump Discharge
SW	Service Waste

EXPOSURE

BUR	Buried
EXP	Exposed
SUB	Submerged

MATERIAL

CLDI	Cement-Lined Ductile Iron
DI	Ductile Iron
GSP	Galvanized Steel Pipe
HDPE	High Density Polyethylene
PVC	Polyvinyl Chloride
SST	Stainless Steel
STL	Steel

PRESSURE TEST

H	Hydrostatic
I	In Service
P	Pneumatic
NA	Not Applicable

JOINT TYPE

BF	Butt Fused
FL	Flanged
PO	Push-on
SW	Solvent Weld
TH	Threaded

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PIPING SCHEDULE

Service Code	Service	Size(s) (In.)	Exposure	Piping Material	Joint Type	Specification Section	Design Pressure (psig)	Test Type	Test Pressure	Pipe Colors and Labels	Applicable Code	Remarks
FW	FW	≥4″	BUR	PVC	PO	15505	175	H	225 Per 15505	Red/White	NFPA 24, FM3-10	
RW	RW	≥4″	BUR	PVC	PO	15060, 15505	80-100	H	150	Green/White	ASME B31.3, FLUID D	
RW	RW	≤2″	BUR	PVC	SW,FL,TH	15060	80-100	H	150	Green/White	ASME B31.3, FLUID D	
RW	RW	≤2″	EXP	GSP	TH	15060, 15505	80-100	H	150	Green/White	ASME B31.3, FLUID D	Service to hose bibbs
SW	SW	All	BUR	HDPE	BF	15021	80-100	H/P	150/4*	Green/White	ASME B31.3, FLUID D	SDR 17
SW	SW	All	EXP	PVC	FL,SW,TH	15060	80-100	H	150	Green/White	ASME B31.3, FLUID D	
SW	LCRS	All	BUR	HDPE	BF	15021	65	H/P	150/4*	Green/White	ASME B31.3, FLUID D	SDR 17, except SDR 11 within landfill cell
SW	LCRS	All	EXP	PVC	SW,FL,TH	15060	65	H	150	Green/White	ASME B31.3, FLUID D	Except cleanouts are HDPE
SW	LDRS	All	BUR	HDPE	BF	15021	65	H/P	150/4*	Green/White	ASME B31.3, FLUID D	SDR 17, except SDR 11 within landfill cell
SW	LDRS	All	EXP	PVC	SW,FL,TH	15060	65	H	150	Green/White	ASME B31.3, FLUID D	
SW	D	All	BUR	HDPE	BF	15021	atm	H	4*	Green/White	ASME B31.3, FLUID D	SDR 17
SW	SPD	All	BUR	HDPE	BF	15021	20	H	30/4*	Green/White	ASME B31.3, FLUID D	SDR 17
SW	SPD	All	EXP	PVC	SW, FL, TH	15060	20	H	30	Green/White	ASME B31.3, FLUID D	

*Double Containment Piping: Carrier pipe tested at the higher pressure; containment pipe tested at the lower pressure except for drains.

SECTION 15100--VALVES AND OPERATORS

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AMERICAN SOCIETY OF SANITARY ENGINEERS (ASSE)

ASSE 1011	Performance Requirements for Hose Connections Vacuum Breakers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A276	Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A351	Standard Specification for Castings, Austenitic, Austenitic-Ferric (Duplex), for Pressure-Containing Parts
ASTM B61	Standard Specification for Steam or Valve Bronze Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B98	Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B127	Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
ASTM B139	Standard Specification for Phosphor Bronze Rod, Bar, and Shapes
ASTM B164	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B194	Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM D429	Test Methods for Rubber Property—Adhesion to Rigid Substrates
ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	Gate Valves for Water and Sewerage Systems
AWWA C504	Standard for Rubber-Seated Butterfly Valves.
AWWA C508	Standard for Swing-Check Valves for Waterworks Service, 2 in. Through 24 in. NPS
AWWA C509	Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C510	Double Check Valve, Backflow-Preventer Assembly
AWWA C511	Required Pressure Backflow-Prevention Assembly
AWWA C540	Power-Actuating Devices for Valves and Sluice Gates
AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
AWWA C606	Grooved and Shouldered Joints
AWWA C800	Underground Service Line Valves and Fittings

MANUFACTURERS STANDARDIZATION SOCIETY (MSS)

MSS SP	Stainless Steel, Bonnetless, Flanged Knife Gate Valves
MSS SP	Diaphragm Type Valves

PART 2--PRODUCTS

GENERAL:

Valve to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and accessories for a complete operation.

Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

Valve same size as adjoining pipe.

Valve ends to suit adjacent piping.

Size operator to operate valve for the full range of pressures and velocities.

Valve to open by turning counterclockwise.

Factory mount operator, actuator, and accessories.

MATERIALS:

Brass and bronze valve components and accessories that have surfaces in contact with liquids other than leachate to be alloys containing less than 16 percent zinc and 2 percent aluminum. Valves in service on leachate lines shall have no bronze, brass, or copper wetted parts.

Approved alloys are of the following ASTM designations:

B61, B62, B98 (Alloy UNS No. C65100, C65500, or C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.

Stainless steel Alloy 18-8 may be substituted for bronze.

FACTORY FINISHING:

Exposed Valves:

Manufacturer's standard corrosion-resistant coating suitable for intended service.

Safety isolation valves and lockout valves with handles, handwheels, or chain wheels "safety yellow."

VALVES:

Gate Valves:

Type V128 Gate Valve 3 Inches and Larger for Buried High Pressure Water Service: Iron body, bronze mounted, mechanical joint, flanged, or other approved ends, double disc gate, nonrising bronze stem, O-ring sealed stuffing box, 2-inch square wrench nut conforming to AWWA C500, rated 250 psi nonshock cold water. Valve shall be UL listed or FM approved for fire protection service, as necessary.

Manufacturers and Products:

Clow: Model F-5707, or equal.

Type V130 Resilient Seated Gate Valve, 3 Inches to 20 Inches: Building Sump Drain Valve.

Iron body, resilient seat, bronze mounted, flanged ends, nonrising stem, 2-inch operating nut, in accordance with AWWA C509, design working water pressure 200 psi for 2 inches through 12 inches and 150 psi for 16 inches and 20 inches, full port, fusion-epoxy coated inside and outside.

Coating to meet requirements of AWWA C550.

Manufacturers:

American AVK.

M & H.

Clow.

Mueller.

U.S. Pipe.

Ball Valves:

Type V330 PVC Ball Valve 2 Inches and Smaller: Rated 150 psi at 73 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, elastomer seat, Viton or Teflon O-ring stem seals, to block flow in both directions.

Manufacturers and Products:

Nibco; True-Bloc.

ASAHI America; Duo-Bloc.

Type V331 PVC Ball Valve 3 and 4 Inches: Rated 150 psi at 73 degrees F, with ASTM D1784 Type I, Grade 1 polyvinyl chloride full port body, Teflon seat, Viton O-ring stem, face and carrier seals, end entry design with dual union, solvent-weld socket ends, or single union ball valve with flanged ends drilled to ANSI B16.1.

Manufacturers and Products:

Nibco.

ASAHI America.

Check and Flap Valve:

Type V609 PVC Swing Check Valve 4 Inches and Smaller: ASTM D1784, Type I, Grade 1, PVC body, rated at 150 psi, Viton seats and seals, flanged ends.

Manufacturer: ASAHI America.

Self-Contained Automatic Valves:

Type V740 Air and Vacuum Valve 1/2 Inch to 16 Inches:

1/2-inch through 3-inch NPT inlets and outlets, 4 inch and larger ANSI B16.1 flanged inlet with plain outlet and protective hoods.

Rated 150 psi working pressure, cast iron, ductile iron, or semi-steel body, cover with stainless steel float and trim.

Manufacturers and Products:

APCO Valve and Primer Corp.; Series 140.

Val-Matic Valve; Series 100.

Miscellaneous Valves:

HV-1, Hose Valve:

Cast bronze angle pattern valve, 1-1/2-inch size, with NPT screwed ends, union bonnet, rising stem, teflon disc, hand wheel, and NPT x NST hose thread adapter outlet connection.

Rated 150-pound service water pressure, 300-pound WOG.

Manufacturers and Products:

Stockham; Figure B-222T.

OPERATORS:

Manual Operator:

General:

Operator force not to exceed 40 pounds under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 40 pounds.

Operator self-locking type or equipped with self-locking device.

Position indicator on quarter-turn valves.

Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threader steel reach rods with internally threaded bronze or ductile iron nut.

Exposed Operator:

Galvanized and painted handwheels.

Lever operators allowed on quarter-turn valves 8 inches and smaller.

Valve handles to take a padlock, and wheels a chain and padlock.

Buried Operator:

Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.

Design buried service operators for quarter-turn valves to withstand 450 foot-pounds of input torque at the FULLY OPEN or FULLY CLOSED positions, grease packed and gasketed to withstand a submersion in water to 10 psi.

Buried valves shall have extension stems, bonnets, and valve boxes.

ACCESSORIES:

T-Handled Operating Wrench:

Two each galvanized operating wrenches, 4 feet long.

Manufacturers and Products:

Mueller; No. A-24610.

Clow No.; F-2520.

Two each galvanized operating keys for cross handled valves.

Extension Bonnet for Valve Operator: Complete with stem and accessories for valve and operator.

Manufacturers:

Pratt.

Allis-Chalmers.

Cast Iron Valve Box: Designed for traffic loads, sliding type, with minimum of 6-inch ID shaft.

Box: Cast iron with minimum depth of 9 inches.

Lid: Cast iron, minimum depth 3 inches, marked WATER.

Extensions: Cast iron.

PART 3--EXECUTION

INSTALLATION:

Flange Ends:

Flanged valve boltholes shall straddle vertical centerline of pipe.

Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

Screwed Ends:

Clean threads by wire brushing or swabbing.

Apply joint compound.

Valve Orientation:

Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.

Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above finish floor, unless otherwise shown.

Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

Extension Stem for Operator: Where the depth of the valve is such that its centerline is more than 3 feet below grade, furnish an operating extension stem with 2-inch operating nut to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover, unless otherwise shown.

END OF SECTION

SECTION 15140--PIPING SUPPORT SYSTEMS

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A525	Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process

BUILDING OFFICIALS AND CODE ADMINISTRATORS (BOCA)

Basic Building Code

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

Uniform Building Code

MANUFACTURERS' STANDARDIZATION SOCIETY (MSS)

SP 58	Pipe Hangers and Supports-Materials, Design and Manufacture
SP 69	Pipe Hangers and Supports-Selection and Application
SP 89	Pipe Hangers and Supports-Fabrication and Installation

DEFINITIONS:

Ferrous Metal: Iron, steel, stainless steel, and alloys with iron as principal component.

Wetted or Submerged: Submerged, less than 1 foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

DESIGN REQUIREMENTS:

General:

Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.

Meet requirements of MSS SP 58, MSS SP 69, and MSS SP 89.

Pipe Support Systems:

Support Load: Dead loads imposed by weight of pipes filled with water, except air and gas pipes, plus insulation.

Safety Factor: Minimum of 5.

Maximum Support Spacing and Minimum Rod Size:

Steel or Ductile Iron Piping:

Pipe Size	Maximum Support/ Hanger Spacing	Minimum Rod Size Single Rod Hangers
1-inch and smaller	6 feet	1/4-inch
1-1/2-inch thru 2-1/2-inch	8 feet	1/4-inch
3-inch and 4-inch	10 feet	3/8-inch

Plastic and Fiberglass Piping:

Maximum Support Spacing: As recommended by manufacturer for flow temperature in pipe. Pipe insulation shall be included in the selection of maximum pipe support spacing.

Minimum Hanger Rod Sizing: Same as listed for steel pipe.

Framing Support System:

Beams: Size such that beam stress does not exceed 25,000 psi and maximum deflection does not exceed 1/240 of span.

Column Members: Size in accordance with manufacturer's recommended method.

Support Loads: Calculate using weight of pipes filled with water.

Maximum Spans:

Steel and Ductile Iron Pipe, 3-Inch Diameter and Larger: 10-foot centers, unless otherwise shown.

Other Pipelines and Special Situations: May require supplementary hangers and supports.

Electrical Conduit Support: Include in design of framing support system.

Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

Vertical Sway Bracing: 10-foot maximum centers, or as shown.

PART 2--PRODUCTS

GENERAL:

When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated by catalogs.

Special support and hanger details are shown for cases where standard catalog supports are inapplicable.

Materials:

Wetted and Submerged: Stainless steel.

Atmospheric Exposed: Galvanized or painted steel.

HANGERS:

Clevis Type: MSS SP 58, Type 1 or 6.

Grinnell; Figure 104 or 260.

B-Line; Figure B3198 or B3100.

Hinged Split-Ring Pipe Clamp: MSS SP 58, Type 6 or 12.

Grinnell; Figure 104.

B-Line; Figure B3198H.

Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

Attachments:

I-Beam Clamp: Concentric loading type, MSS SP 58, Type 21, 28, 29, or 30, which engage both sides of flange.

Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.

SADDLE SUPPORTS:

Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.

Nonadjustable Saddle: MSS SP 58, Type 37 with U-bolt.

Grinnell; Figure 259.

B-Line; Figure B3090.

Adjustable Saddle: MSS SP 58, Type 38 without clamp.

Grinnell; Figure 264.

B-Line; Figure B3093.

WALL BRACKETS:

Welded Steel Bracket: MSS SP 58, Type 33 (heavy-duty).

Grinnell; Figure 199.

B-Line; Figure B3607.

One-Hole Clamp: Grinnell; Figure 126.

Channel Type:

Unistrut.

Kin-Line.

PIPE CLAMPS:

Riser Clamp: MSS SP 58, Type 8.

Grinnell; Figure 261.

B-Line; Figure B3373.

CHANNEL TYPE SUPPORT SYSTEMS:

Material:

Galvanized: Pre-galvanized in accordance with ASTM A525, Class G90, or hot-dip galvanized after fabrication.

Stainless Steel: Type 304 stainless steel.

Channel Size: 12-gauge, 1-5/8-inch wide series minimum.

Members and Connections: Design for all loads with safety factor of 5.

Manufacturers and Products:

Kin-Line; Series CI3812.

Unistrut; Series P3200.

ANCHORING SYSTEMS:

Material:

Wetted and Submerged: Stainless steel.

Atmospheric Exposed: Galvanized.

Size: Sized by equipment manufacturer, 1/2-inch minimum diameter.

SHOP/FACTORY FINISHING:

Prepare, prime, and finish coat in accordance with:

Surface preparation with abrasive blast or centrifugal wheel blast (SP10).

Paint with:

One coat, 2.5 minimum dry film thickness (MDFT) of Epolon rust inhibitor primer.

One coat, 2.5 MDFT Epolon Multi-Mill Epoxy.

One coat, 1.5 MDFT Acrolon II, No. 2200 Series.

PART 3--EXECUTION

INSTALLATION:

General:

Install support systems in accordance with MSS SP 69, Pipe Hangers and Supports-Selection and Application and MSS SP 89, Pipe Hangers and Supports-Fabrication and Installation, unless shown otherwise.

Support piping connections to equipment by pipe support and not by the equipment.

Support large or heavy valves, fittings, and appurtenances independently of connected piping.

Support no pipe from the pipe above it.

Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.

Do not install pipe supports and hangers in equipment access areas or bridge crane runs.

Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing.

Install lateral supports for seismic loads at all changes in direction.

Repair mounting surfaces to original condition after attachments are made.

Standard Pipe Supports:

Horizontal Suspended Piping:

Single Pipes: Adjustable swivel-ring, splint-ring, or clevis hangers.

Grouped Pipes: Trapeze hanger systems.

Furnish galvanized steel protection shield and oversized hangers for all insulated pipe.

Furnish precut sections of rigid insulation with vapor barrier at hangers for all insulated pipe.

Horizontal Piping Supported From Walls:

Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.

Stacked Piping:

Wall-mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.

Piping clamps which resist axial movement of pipe through support not acceptable.

Wall-mounted piping clips not acceptable for insulated piping.

Horizontal Piping Supported From Floors:

Stanchion Type:

Pedestal type; adjustable with stanchion, saddle, and anchoring flange.

Use yoked saddles for piping whose centerline elevation is 18 inches or greater above the floor and for all exterior installations.

Floor Mounted Channel Supports:

Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.

Attach channel framing to floors with anchor bolts.

Attach pipe to channel with clips or pipe clamps.

Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.

Standard Attachments:

To Steel Beams: I-beam clamp or welded attachments.

To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.

FIELD FINISHING:

Paint atmospheric exposed surfaces of black and hot-dip galvanized steel components as specified in Article SHOP/FACTORY FINISHING.

END OF SECTION

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SECTION 15505--UNDERGROUND FIRE PROTECTION PIPING

PART 1--GENERAL

WORK DESCRIPTION:

The Subcontractor shall furnish all labor, materials, equipment, and supplies and perform all work and operations necessary to design and install an underground fire protection system in accordance with the Drawings and this Specification. Unless otherwise specified, references in this Specification to other Specifications, codes, standards, or manuals shall be the latest edition including any amendments and revisions in effect as of the date of this Specification.

WORK INCLUDES:

Work includes, but is not limited to: Design, fabricate, install and test a complete underground supply system including pipe, fittings, thrust blocks, rodded connections, supports, bracing, expansion joints, and all necessary accessories and components to assure a complete and operable system. Subcontractor shall be responsible for coordinating all existing and new work.

REFERENCE DRAWINGS:

General: The reference drawings do not attempt to show complete details of the site utilities which affect the fire protection installation. The drawings in part are diagrammatic and do not show all offsets, fittings, valves, equipment, etc. It is absolutely essential to study the architectural, structural, mechanical, and electrical drawings and confer with the various trades involved, to the end that there is no conflict between the fire protection system and the work of other trades and to assure that the owner secures the best arrangement of work consistent with the use of space.

PART 2--PRODUCTS

GENERAL:

All materials, products, and equipment shall be as manufactured by the manufacturer specified in this section or approved equal. All components shall be rated for a working pressure of 175 psi, whether stated or not.

All products shall comply with National Fire Protection Association (NFPA) No. 24 and FM 3-10, "Private Fire Service Mains." All products shall be provided with a UL listing or FM approval.

UNDERGROUND PIPE:

The following materials shall be rated for a working pressure of 175 psi, 6-foot minimum depth coverage top of pipe, and truck load of AASHTO H-20 unpaved road, and 1.5 impact factor and calculations according to ANSI/AWWA C150/A21.50 and C150/A21.51. The water pipeline shall be sized and installed as shown on the Drawings.

PVC PIPE:

Underground fire water and raw water pipe shall be Class 200 PVC pipe listed for critical use in firelines. Pipe shall meet AWWA C900. Pipe shall be UL listed and FM approved, J.M. PIPE; or approved equal.

DUCTILE IRON FITTINGS:

Underground fittings shall be ductile iron mechanical or slip joint, and conform to the mechanical properties of ANSI/AWWA C151/A21.51, UL Listed, cement lined per AWWA C104/A121.4.

FIRE HYDRANTS:

The Subcontractor is responsible to assure that hydrants and valves are installed to proper finished grade. Hydrants shall be UL-listed or FM-approved two-way with road box and key valve. The hydrants must be approved for the appropriate climate, minimum of 6-foot bury to Top-of-Pipe (T.O.P.). Hydrants shall be set so that the 2-1/2-inch hose connections are 20 inches (plus or minus 2 inches) above finished grade level.

Hydrants shall open counterclockwise. The hydrants shall have two 2-1/2-inch hose connections and one 4-1/2-inch pumper connection, all with National Standard fire hose threads. The 4-1/2-inch pumper connection shall face towards the fire truck pumper for access.

Hydrants shall be dry barrel type gate valves UL-listed or FM-approved with a 5-1/4-inch valve opening. Hydrants shall have drain holes and mechanical joint (MJ), flanged, or TYTON connections. The hydrants shall be Clow Medallion, Model No. F2536, as manufactured by the Clow Valve Co.; or approved equal.

KEY VALVE WITH ROAD BOX:

Buried gate valve in accordance with Section 15100, VALVES AND OPERATORS.

WRAPPING:

Underground ductile iron pipe, fittings, valves, hydrants, and metallic fasteners shall be wrapped with polyken 920 20-mil wrap or approved equal and be coated with the

manufacturer's standard asphaltic coating or equivalent. Rodding shall be coated by the Subcontractor using an asphaltic material and then be wrapped with polyken 920 20-mil wrap or approved equal. Wrapping to be completed per manufacturer's instructions with a minimum of 50 percent overlap.

THRUST BLOCKS:

Thrust blocks and rodding shall be sized and installed in accordance with NFPA 24, 8-6. Size thrust blocks for loose sand and gravel conditions per NFPA 24 A-8-6.2.8. Soil conditions are to be considered as a Class III soil with a maximum 3,000 psi horizontal bearing strength. Thrust blocks shall be poured using formwork.

Thrust blocks shall be designed by a NICET engineering technician certified in Fire Protection with a minimum Level III rating or a PE registered in the State of Idaho.

UNDERGROUND PIPE IDENTIFICATION:

New underground fire water pipelines shall be identified by use of a plastic ribbon no less than 3 inches in width with a message printed on the ribbon which identifies the actual pipeline contents. The ribbon shall be wrapped around the pipeline at no less than one wrap per 3 feet of run. The plastic ribbon shall be color coded in conformance with the following:

Categories of Pipeline Contents	Tape	Lettering
Fire Water	Red	White

PART 3--EXECUTION

GENERAL:

Installation: Only new and approved pipe, fittings, and devices shall be employed in the installation of the underground system.

One set of approved installation shop drawings shall be maintained on the project site during construction. The Subcontractor shall redline all changes daily. The redline drawings shall be incorporated on the "as-built" design drawings by the Subcontractor.

Underground fire water piping, fittings, and valves shall meet requirements of, and be installed in accordance with NFPA 24, and FM 3-10. Thrust blocks, rodding or equivalent restraints shall be provided for one piping section length on each side of fittings which result in a change of direction.

Underground control valves for the fire hydrant lines shall be provided with a valve box extending to finished grade level and with stem extension extending to 6 inches below grade.

Locator Ribbon:

Locator ribbon shall be installed as specified in Section 02320, TRENCH BACKFILL.

END OF SECTION 15505

SECTION 15992--PIPING LEAKAGE TESTING

PART 1--GENERAL (NOT USED)

PART 2--PRODUCTS (NOT USED)

PART 3--EXECUTION

PREPARATION:

Notify BBWI Construction Manager in writing 5 days in advance of testing. Perform testing in presence of BBWI Construction Manager.

Pressure Piping:

Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.

Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.

Items that do not require testing include: Piping between wetwells and wetwell isolation valves, tank overflows to atmospheric vented drains, tank atmospheric vents, and perforated piping.

Test section may be filled with water and allowed to stand under low pressure prior to testing.

Gravity Piping:

Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.

Determine groundwater level at time of testing by exploratory holes or other method acceptable to BBWI Construction Manager.

HYDROSTATIC TEST:

General: Hydrostatic testing shall be performed on all single-wall pipe, inner carrier pipes, and all PVC piping.

Fluid: Clean water of such quality to prevent corrosion of materials in piping system.

Test Pressure:

Gravity Piping: Per Section 15060, PIPING—GENERAL.

Pressure Piping: Per Section 15060, PIPING—GENERAL.

Exposed Piping:

Perform testing on installed piping prior to application of insulation.

Maximum Filling Velocity: 0.25 feet per second, applied over full area of pipe.

Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.

Maintain hydrostatic test pressure continuously for 30 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage. No fluid shall be added to the system, and system shall not drop below 95 percent of the test pressure during the test period.

Examine exposed joints and connections for leakage.

No leakage allowed. Correct visible leakage and retest as specified.

Empty pipe of water prior to final cleaning or disinfection.

Buried Piping:

Pipe with Welded, Glued, or Fusion Bonded Joints:

Test piping using the same procedure as outlined for exposed piping as modified above.

After filling pipe with test fluid, allow the pipe to sit for 24 hours for the fluid temperature to stabilize.

Test pressure shall not drop below 98 percent of the initial test pressure during a 1-hour test period.

Examine exposed joints and connections for leakage.

No leakage allowed. Correct visible leakage and retest as specified.

Empty pipe of water prior to final cleaning or disinfection.

Pipe with Gasketed Joints:

Test after backfilling, as specified in Section 02320, TRENCH BACKFILL, has been completed.

Expel air from piping system during filling.

Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.

Maintain hydrostatic test pressure continuously for 2 hours minimum, reopening isolation valve only as necessary to restore test pressure.

Determine actual leakage by measuring quantity of water necessary to maintain specified test pressure for duration of test.

Maximum Allowable Leakage:

$$L = \frac{SD(P)^{1/2}}{133{,}200}$$

where:

L	=	Allowable leakage, in gallons per hour.
S	=	Length of pipe tested, in feet.
D	=	Nominal diameter of pipe, in inches.
P	=	Test pressure during leakage test, in pounds per square inch.

Correct leakage greater than allowable, and retest as specified.

PNEUMATIC TEST:

General: Pneumatic testing shall be performed for outer pipe of double-wall HDPE piping.

Double-Wall Pipe: Inner carrier pipe shall be full of water when outer containment pipe is tested to prevent damage to carrier pipe.

Equipment:

Calibrate gauges with standardized test gauge provided by Construction Manager at start of each testing day. Construction Manager will witness calibration.

Install gauges, air piping manifolds, and valves at ground surface.

Provide pressure release device, such as rupture disc or pressure relief valve, to relieve pressure at 5 psi or less.

Restrain plugs used to close lines to prevent blowoff.

Procedure:

Require that no person enter manhole where pipe is under pressure.

Slowly introduce air into pipe section until internal air pressure reaches required test pressure.

Allow 2 minutes minimum for air temperature to stabilize.

Examine exposed joints and connections for leakage.

No leakage allowed. Correct visible leakage and retest as specified.

Defective Piping Sections: Replace or test and seal individual joints, and retest as specified.

END OF SECTION 15992

SECTION 16005--ELECTRICAL

PART 1--GENERAL

REFERENCES:

The following is a list of standards which may be referenced in this section:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	Rigid Steel Conduit-Zinc Coated.
ANSI C80.3	Electrical Metallic Tubing-Zinc Coated.
ANSI C80.5	Aluminum Rigid Conduit.
ANSI C80.6	Intermediate Metal Conduit (IMC)-Zinc Coated.

FEDERAL SPECIFICATIONS (FS)

FS W-C-596	Connector, Receptacle, Electrical.
FS W-S-896	Switches, Toggle, Flush Mounted.

NATIONAL ELECTRICAL CONTRACTOR'S ASSOCIATION, INC. (NECA)

NECA 5055	Standard of Installation.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	Molded Case Circuit Breakers and Molded Case Switches.
NEMA 250	Enclosures for Electrical Equipment (1,000 Volts Maximum).
NEMA ICS 2	Standard for Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts ac or 750 volts dc.
NEMA PB 1	Panelboards.
NEMA ST 20	Dry-Type Transformers for General Applications.
NEMA TC 2	Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
NEMA TC 3	PVC Fittings for Use with Rigid PVC Conduit and Tubing.
NEMA WD 1	General Requirements for Wiring Devices.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code (NEC).
NFPA 72	Fire Alarm Code.

UNDERWRITERS LABORATORIES, INC. (UL)

UL 1	Standard for Safety Flexible Metal Conduit.
UL 651	Standard for Safety Schedule 40 and 80 PVC Conduit.
UL 845	Standard for Safety Motor Control Centers.
UL 1561	Standard for Dry-Type General Purpose and Power Transformers.

UL COMPLIANCE:

Materials manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL listing mark.

ELECTRICAL DESCRIPTION OF WORK:

Provide and install power conduits and cables to electrical service gear for each crest pad building. Power conduits and cables shall route from crest pad building electrical service gear to utility power manhole provided by INEEL and as shown on Drawings.

Provide and install communication conduits and cables for each crest pad building communication service. Communication conduits and cables shall route below grade from crest pad building communication panel (i.e., pump control, paging, fire alarm) to utility communication manholes provided by INEEL and as shown on Drawings.

Provide and install electrical service gear for each crest pad building including: motor control center (MCC), MCC integrally mounted lighting panel and transformer, and grounding electrode system.

Motor control center shall provide 480V, three-phase, 3-wire power to pump motors, building heaters, and control panel with motor starters.

Lighting panel and transformer shall provide 208/120V, three-phase, 4-wire power for instruments, lighting, receptacles, small motor loads, and miscellaneous panels.

Provide and install grounding electrode system at each crest pad building. Bond service gear, lighting transformer, power and communication panels, and building metal structures to grounding electrode system.

Provide and install power conduits and cables to the following three-phase equipment:

Crest pad building unit heaters.

Crest pad building air conditioning units.

Crest pad building generator plugs and receptacles.

Landfill leachate collection and leak detection recovery system pumps.

Evaporation pond leak detection recovery system pumps.

Combined sump pump.

Transfer pump.

Provide and install power conduits and cables to the following single-phase equipment:

Crest pad building interior and exterior lighting.

Crest pad building receptacles.

Crest pad building control and alarm panels.

Crest pad building voice pager panels.

Crest pad building fire alarm panels.

Provide and install control and signal conduits and cables to the following instrumentation:

Crest pad building temperature transmitters.

Crest pad building sump level floats and panels.

Crest pad building fire detector and manual pull stations.

Crest pad building ventilation thermostats.

Landfill leachate collection and leak detection recovery system pump flow meters and submersible pressure transmitters.

Evaporation pond leak detection recovery system pump flow meters and submersible pressure transmitters.

Landfill leachate collection carrier pipe leak detection level switches.

Evaporation pond truck loading flow meters and transmitters.

Evaporation pond combined sump and SSSTF wastewater flow meters.

Raw water flow meter and transmitter.

Truck loading flow meter and transmitter.

SSSTF line VARV high level float.

ENVIRONMENTAL CONDITIONS:

Provide equipment and conduit systems approved for installing in the following environmental conditions:

Climatic and Geographic Site Conditions:

Site Elevation: 4,917 feet.

Barometric Pressure: 12.27 psia.

Relative Humidity: 90 percent maximum at 30 degrees F dry bulb, 15 percent minimum at 60 degrees F dry bulb.

Uniform Building Code: Seismic Zone 2B.

Temperature: +40 degrees C max. -40 degrees C min.

Provide NEMA 3R enclosures for all outdoor equipment and NEMA 12 and NEMA 4X for all indoor equipment as noted on Drawings and in this Section.

Labeling: Install permanent labels on all electrical panels, cabinets, disconnects, motor starters, major equipment or components, receptacles, and switches.

PART 2--PRODUCTS

GENERAL:

Products shall comply with all applicable provisions of NFPA 70.

Like Items of Equipment: End products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts, and manufacturer's service.

Equipment and Devices Installed Outdoors or in Unheated Enclosures: Capable of continuous operation within ambient temperature range of -40 degrees C to +40 degrees C.

Corrosive Areas: Products shall be acceptable to the regulatory authority having jurisdiction for the corrosive area indicated.

Hazardous Areas: Products shall be acceptable to the regulatory authority having jurisdiction for the combined sump area. Class 1, Division I.

Equipment Finish: Manufacturer's standard finish color, except where specific color is indicated.

SERVICE ENTRANCE:

Meet requirements of Operating Contractor.

Provide conduits and pull boxes to facilitate routing of power and telephone telemetry to new station.

LIGHTING AND POWER DISTRIBUTION PANELBOARD:

NEMA PB 1, NFPA 70, and UL 67.

Panelboards and Circuit Breakers: Suitable for use with 75 degrees C copper wire at full NFPA 70, 75 degrees C ampacity.

Short-Circuit Current Equipment Rating: Fully rated; series connected unacceptable.

Rating: Applicable to a system with available short-circuit current of 10,000 amperes rms symmetrical at 120/208 volts.

Ground Fault Circuit Interrupter (GFCI): UL Class A GFCI, 5-mA trip, 10,000-amp interrupting capacity circuit breakers.

Ground Fault Equipment Protection (GFEP): 30-mA trip, 10,000-amp interrupting capacity circuit breaker, UL listed for equipment ground fault protection.
Interior Panelboard:

NEMA 250, Type 12 unless otherwise noted.

Material: Code-gauge, hot-dip galvanized sheet steel, with reinforced steel frame.

Wiring Gutter: Minimum 4 inches square; both sides, top and bottom.

Front: Fastened with adjustable clamps.

Interior:

Factory assembled; complete with circuit breakers.

Capable of circuit breaker replacement without disturbing adjacent circuit breakers or without removing main bus.

Spaces: Cover openings with easily removable metal cover.

Circuit Directory: Metal frame with transparent plastic face and enclosed card on interior of door.

Bus Bar:

Material: Copper and/or tin-plated copper full sized throughout length.

Provide for mounting of future circuit breakers along full length of bus regardless of number of units and spaces shown. Machine, drill, and tap as required for current and future positions.

Neutral: Insulated, rated same as phase bus bars, with at least one terminal screw for each branch circuit.

Neutral bus with at least two (neutral and ground) terminal screws for each circuit.

Note: Do not install multiwire branch circuits that share common neutral. Install neutral for each 120-volt branch circuit.

Lugs and Connection Points:

Suitable for copper conductors.

Solderless main lugs for main, neutral, and ground bus bars.

Bolt together and rigidly support bus bars and connection straps on molded insulators.

Circuit Breakers:

NEMA AB 1 and UL 489.

Thermal-magnetic, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle.

Noninterchangeable, in accordance with NFPA 70.

Locking: Provisions for handle padlocking, unless otherwise shown.

Type: Bolt-on circuit breakers in all panelboards.

Multipole circuit breakers designed to automatically open all poles when an overload occurs on one pole.

Do not substitute single-pole circuit breakers with handle ties for multipole breakers.

Do not use tandem or dual circuit breakers in normal single-pole spaces.

Ground Fault Circuit Interrupter (GFCI):

Equip with conventional thermal-magnetic trip and ground fault sensor rated to trip in 0.025 second for a 5-mA ground fault (UL 943, Class A sensitivity).

Sensor with same rating as circuit breaker and a push-to-test button.

Manufacturers:

Allen-Bradley.

Cutler-Hammer/Westinghouse.

General Electric.

Square D.

LIGHTING AND POWER DISTRIBUTION STEPDOWN TRANSFORMER (0-600 VOLTS):

Type: Self-cooled, two-winding.

UL 1561 and NEMA ST 20.

Insulation Class/Temperature Rise: 115 Degrees F.

Core and Coil:

30 kVA or Less: Encapsulated.

Voltage Taps: Full capacity, 2-1/2 percent, two above and two below normal voltage rating.

Sound Level: Not to exceed NEMA ST 20 levels.

Vibration isolators to minimize and isolate sound transmission.

Manufacturers:

Allen-Bradley.

Cutler-Hammer/Westinghouse.

General Electric.

Square D.

CONTROL PANELS:

Enclosure:

NEMA 250, Type 12 unless otherwise noted.

Minimum Metal Thickness: 14 gauge.

Doors: Rubber gasketed with continuous hinge.

Incandescent Light: Hand switch controlled, 100-watt.

Receptacle: Breaker protected 120-volt, 15-amp duplex.

Finish: Internal and external surfaces:

Sand panel; remove mill scale, rust, grease, and oil.

Fill imperfections and sand smooth.

Paint with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.

Sand surfaces lightly between coats.

Final Dry Film Thickness: Minimum 3 mils.

Size panels to adequately dissipate heat generated by equipment mounted in or on panel.

Manufacturers:

Hoffman.

H. F. Cox.

Wiring:

Power and Control Wiring: 600-volt class, insulated, stranded copper.

Size: Minimum No. 14 AWG enclosed in either sheet metal raceway or plastic wiring duct.

Signal Circuit Wiring: Twisted shielded pairs minimum No. 16 AWG, separated at least 6 inches from power wiring.

Identification: Permanent heat impregnated polyvinyl chloride (PVC) alpha-numeric labels.

SAFETY SWITCHES:

Type: Visible blade, fusible.

Class: Heavy-duty.

Enclosures:

Indoor Installations: NEMA 250, Type 4X.

Outdoor Installations: NEMA 250, Type 3R raintight.

CIRCUIT BREAKERS:

NEMA AB 1.

Indicating type, with ON/OFF and TRIPPED positions of the operating handle.

Bolt-on thermal-magnetic, quick-make, quick-break noninterchangeable.

Tandem or dual circuit breakers in normal single-pole spaces not permitted.

SPECIAL RACEWAYS: MULTI-CELL PVC RACEWAY

General: UL listed Multiple Celled raceway system utilizing pre-lubricated PVC inner-ducts for installation of voice, data, video and other low voltage cabling.

System Description: Industry standard communication outer ducts and inner ducts meeting the performance requirements of this specification. Fixed and flexible bends shall be allowed for changes in direction. A gasket coupling mechanism shall be provided with terminators for field assembly without lubricants.

All materials shall be furnished by the same manufacturer.

Materials:

Outer-Duct: PVC outer-duct with printline stating "INSTALL PRINTLINE UP."

Type 40 UL listed for direct burial and concrete encasement.

Standard and heavy wall construction shall consist of fiberglass-reinforced epoxy for mechanical and UV protection.

Outer-Duct Performance Requirements:

Minimum Stiffness: 72 degree F: 370 lbs/in/in.

Minimum Bell OD: 5. 00 inches.

Outer-Duct OD: 4.50 inches.

Impact Values: 72 Degrees F: 220 ft/lbs.

Maximum Joint Insertion Force: 80 lbs.

Maximum Joint Separation Force: 200 lbs.

Minimum Joint Water Infiltration: 11 PSI.

Minimum Lay Length: 20 feet.

Flexible Bend Minimum Radius: 4 feet.

Inner-Duct: Three-cell Type 40 multi-colored inner-ducts provided as (three-cell white/gray/orange). PVC inner-ducts in straight length shall be pre-lubricated. One white inner-duct shall be under the print line with other inner-ducts being gray. Inner-ducts shall not cut through when subject to 1/4-inch polypropylene rope pulled at 100 ft/min and at 45-pound tension for 100 minutes as tested in accordance with Bellcore procedures.

A non-cemented spacer system shall be installed in the outer-duct to hold all three-cell inner-ducts in a triangular configuration.

Inner-Duct Performance Requirements:

Minimum Stiffness: 72 degree F: 140 lbs./in/in.

Minimum OD: 4.50 inches.

Inner-Duct OD: 1.66 inches.

Inner-Duct ID: 1.50 inches.

Air Burst Pressure Rating: 200 PSI.

COF Requirements TSY-356: .06-.09 pass.

Cut-Through-Testing TSY-356: 100 min pass.

Flexible Bend Minimum Radius: 4 feet.

PVC Multi-Cell Fixed Bends with Bell: Multi-guard fixed bends which use the same coupling design as straight section. All bends shall be provided with plastic inner-ducts to avoid rope cut-through.

PVC Multi-Cell Flexible Bends with Bell: Multi-guard flexible bends capable of a 4-foot minimum bend radius and use the same coupling design as straight section. All bends shall be provided with plastic inner-ducts to avoid rope cut-through.

Accessories: Provide slip couplings to allow male-to male connections, termination kits for vaults, handholes and enclosures, and line blowing kits.

Manufacturers and Product Number: Carlon Systems Multi-Gard; MFSS3S-020-C.

CONDUIT AND FITTINGS:

Rigid Galvanized Steel Conduit (RGS):

ANSI C80.1.

Fittings: Threaded type.

Galvanize by hot-dipping, electroplating, sherardizing, or metalizing process, including fittings.

Polyvinyl Chloride Conduit (PVC):

Rigid, Schedule 40, NEMA TC 2.

UL 651 listed for concrete encased, direct burial, concealed and direct sunlight exposed use.

UL 651 listed and marked for use with conductors having 90 degrees C insulation.

Fittings: NEMA TC 3, for intended use.

Flexible Metal Liquid-Tight Conduit:

UL 1 listed for liquid-tight service.

Galvanized steel, flexible conduit covered with extruded PVC jacket.

Termination: Nylon bushings or bushings with steel or malleable iron body and insulated throat and sealing O-ring.

Conduit Sealing Fitting:

Restrict the passage of gasses, vapors, or flames from one portion of the electrical installation to another at atmospheric pressure and normal ambient temperatures.

In conduit systems when leaving Class 1, Division 1 or Division 2 hazardous locations.

Manufacturers and Products:

Appleton; Type EYF, EYM, or ESU.

Crouse-Hinds; Type EYS or EZS.

Fitting Sealing Compound: Form a seal around each electrical conductor and between them and inside of the sealing fitting to restrict the passage of gases, vapors, or flames through the sealing fitting.

Manufacturers and Products:

Appleton; Kwiko.

Crouse-Hinds; Chico.

SUPPORT AND FRAMING CHANNELS:

Carbon Steel Framing Channel:

Material: Rolled, mild strip steel, 12-gauge, ASTM A570, Grade 33.

Finish: Hot-dip galvanized after fabrication.

Paint-Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.

Manufacturers:

B-Line Systems, Inc.

Unistrut Corp.

Aickinstrut.

PRECAST HANDHOLES:

Concrete Strength: Minimum 3,000 psi compressive, in 28 days.

Loading: AASHTO H-20, in accordance with ASTM C857.

Drainage: Slope floors toward drain points, leaving no pockets or other nondraining areas.

Raceway Entrances:

Provide on all four sides along with pulling eyes.

For raceways to be installed under this Contract, provide knockout panels or precast individual raceway openings.

At entrances where raceways are to be installed by others, provide minimum 12-inch high by 24-inch wide knockout panels for future raceway installation.

Handhole Frames and Covers:

Material: Steel, hot-dipped galvanized.

Cover Type: Solid, torsion spring of checkered diamond design.

Cover Loading: AASHTO H-20.

Cover Designation: Burn by welder, on upper side in integral letters, minimum 2 inches in height, appropriate titles:

600 Volts and Below: ELECTRIC LV.

TELEPHONE.

Hardware: Steel, hot-dip galvanized.

Furnish knockout for ground rod in each handhole.

Manufacturers:

Utility Vault Co.

Penn-Cast Products, Inc.

Concrete Conduit Co.

Associated Concrete Products, Inc.

Pipe, Inc.

CONDUCTORS:

Material: Annealed copper.

Insulation:

No. 8 AWG and Smaller: Type THHN/THWN.

No. 6 AWG and Larger: Type XHHW.

Direct Buried: Type XLPE-USE.

Flexible Cord and Cable: Type SO, 600 volts.

Signal: Type 3, No. 16 AWG twisted, shielded pair instrumentation cable, 45-mil PVC outer jacket, 600-volt rating.

Type:

Control Conductor No. 14 AWG and Smaller: Stranded.

Power Conductors No. 10 AWG and Smaller: Solid or stranded.

Power Conductors No. 8 AWG and Larger: Stranded.

Type 3: No. 16 AWG stranded (copper seven-stranded)

TERMINAL BLOCKS AND ENCLOSURES:

Provide NEMA 4X enclosures for all indoor and outdoor terminal block applications.

Type: Compression screw clamp, with current bar providing direct contact with wire and yoke, with individual rail mounted terminals.

Yokes and Clamping Screws: Zinc-plated, hardened steel.

Rating: 600V ac.

PUSHBUTTONS AND SELECTOR SWITCHES:

NEMA ICS 2, Type 600.

Type: Heavy-duty, oiltight.

Lockout: Pushbuttons and selector switches shall lock in OFF position wherever lockout provisions are indicated.

Nameplates:

Individual, large, laminated plastic.

Function indicated.

Pushbutton station nameplates shall indicate the drive controlled.

Manufacturers and Models:

Allen-Bradley; 800E.

Square D; Type T.

Cutler-Hammer; Type 10250T.

LUMINAIRES:

Specific requirements relating to fixture type, lamp type, and mounting hardware is located in the Luminaire Schedule attached to this section.

RECEPTACLES:

NEMA WD 1 and FS W-C-596.

Specification Grade:

Type: Three-wire grounding, with screw type terminals suitable for No. 10 AWG wire. Contact to be made on two sides of each inserted blade without detent.

Number of Poles: Two.

Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.

Base: Phenolic composition.

Color: Gray.

SPECIAL RECEPTACLE AND PLUG:

Specification Grade:

Type: Three-wire, grounding Style 2.

Number of Poles: Four.

Rating: 100 amps, 600V ac.

Color: Gray.

Manufacturers and Products:

Crouse-Hinds:

Receptacle Assembly: AR.

Plug: APJ.

Appleton:

Receptacle Assemply: ADJA.

Plug: ACP.

SWITCHES:

NEMA WD 1 and FS W-S-896E.

Totally enclosed, ac type, quiet tumbler switches, with screw terminals.

Capable of control of 100 percent tungsten filament and fluorescent lamp loads.

Rating: 20 amps, 120/277 volts (single and double-pole as required).

Color: Gray.

BOXES:

Small Standard Boxes:

NEMA 250, Type 1, minimum 2 inches deep, unless shallower required by structural conditions.

Large Galvanized Steel Boxes:

NEMA 250, Type 12 unless otherwise noted.

14-gauge, with full access screw covers mounted with corrosion-resistant machine screws.

Large Cast Metal Boxes:

NEMA 250, Type 4, cast malleable iron, with hot-dip galvanized finish.

Neoprene gasketed, watertight, with cast metal covers, stainless steel screws, and drilled and tapped conduit entrances.

Handholes:

Reinforced cast concrete boxes sized to provide adequate working space as required by standard procedures and NFPA 70.

Nonmetallic:

Box: PVC.

Cover: PVC, weatherproof, with stainless steel screws.

Manufacturer and Product: Carlon; Type FS or FD, with Type E98 or E96 covers.

Large Nonmetallic Box:

NEMA 250, Type 4X.

Box: High-impact, fiberglass-reinforced polyester or engineered thermoplastic, with stability to high heat.

Cover: Hinged with clamps.

Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.

Conduit hubs and mounting lugs.

Manufacturers and Products:

Crouse-Hinds; Type NJB.

Carlon; Series N, C, or H.

Robroy Industries.

COVER PLATES:

Metal:

Material: Specification grade, one-piece, stainless steel.

Thickness: Minimum 0.40-inch nominal.

Finish: No. 302/304 satin.

Mounting Screws: Oval head, stainless steel, to match plate.

Cast Metal:

Material: Malleable ferrous, with gaskets.

Mounting Screws: Oval head, stainless steel.

Weatherproof Device Plates:

Material: Cast metal, gasketed, weatherproof, with individual cap over each opening held with stainless steel springs.

Finish: Stainless steel or fiberglass reinforced plastic.

Mounting Screws: Stainless steel.

GROUNDING:

General:

Grounding shall be in compliance with NFPA 70 and ANSI C2.

Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.

Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.

Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

Shielded Instrumentation Cables:

Ground shield of instrumentation cables at PLC end only, using drain wire connected to terminal block that is connected to an isolated instrument ground. Isolated instrument ground terminals block is located inside PLC control panel enclosure.

Insulate ungrounded end of all shielded instrumentation cables' shield with shrink tubing for a distance of 1/2 inch either side of the end of the outer jacket.

Wire Connections:

Ground Conductors: Install in conduit containing power conductors and control circuits.

Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor and bond at both ends.

Connect ground conductors to raceway grounding bushings.

Bond all equipment grounding conductors to equipment ground bus and equipment enclosures as required by the NEC.

Bolt connections to equipment ground bus.

Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

Motor Grounding:

Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor and bond at both ends.

Motors Less Than 10 hp: Furnish compression, spade-type terminal connected to conduit box mounting screw.

Motors 10 hp and Above: Tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.

Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

Grounding Conductors:

Equipment: Solid or stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.

Direct Buried: Bare stranded copper.

Isolated Instrument Ground: Stranded copper with green insulation with yellow stripe or yellow phasing tape at all ends.

Ground Rod:

Material: Copper.

Diameter: Minimum 3/4 inch.

Length: 10 feet.

Connectors:

Exothermic Weld Type:

Outdoor Weld: Suitable for exposure to elements or direct burial.

Indoor Weld: Utilize low-smoke, low-emission process.

Manufacturers: Erico Products, Inc., Cadweld and Cadweld Exolon.

Compression Type:

Compress-deforming type; wrought copper extrusion material.

Single indentation for conductors 6 AWG and smaller.

Double indentation with extended barrel for conductors 4 AWG and larger.

Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.

Manufacturers:

Burndy Corp.

Thomas and Betts Co.

ILSCO Corp.

Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

Manufacturers:

Burndy Corp.

Thomas and Betts Co.

ILSCO Corp.

Grounding Wells:

Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.

Manufacturers and Products:

Christy Co.; No. G5.

Lightning and Grounding Systems, Inc.; I-R Series.

VOICE PAGER AND FIRE ALARM SYSTEM FPCP-1,-2, ECS-CD-1798,-1799:

Provide and install inside each Crest Pad Building the following voice pager and fire alarm system compatible with existing INEEL systems:

Fire Alarm Detectors(two each minimum per building): System Sensor Model 2151 with Model B401B face.

Manual Fire Alarm Pull Boxes (one each per building): Manual fire alarm pull boxes shall be double-action type with single-pole double-throw contacts mounted on a back box. Note: "Break Glass" types are not acceptable.

Audible Visual Occupant Notification Device (one each per building): System Sensor Model P24(Cd rating) for wall-mounted units. Audible devices shall be UL 464 listed and visual devices shall be UL 1971 listed.

Fire Alarm and Voice Pager (one each per building): Digital Alarm Communications Transmitter (DACT) shall be an Firelite Model 911 which will communicate over standard dial tone circuits with an Ademco Model 685 DACR using Radionics BFSK communications protocol located in the Fire Alarm Center in CFA 666. The DACT shall be UL listed.

Wire all components in accordance with manufacturing requirements and INEEL applicable standards. Provide 120V ac power to fire alarm and voice pager panel. Integrate fire alarm and voice pager system into PICS control panel as shown.

PART 3--EXECUTION

GENERAL:

All work shall be performed in a neat and workman-like manner and shall comply with all applicable provisions of NECA 5055 standards and practices.

Install materials and equipment in corrosive areas in a manner acceptable to regulatory authority having jurisdiction for the corrosive area indicated.

Ground equipment, enclosures, and complete conduit system securely in accordance with applicable sections of NFPA 70.

MOTOR STARTER:

Field adjust trip settings of motor starter magnetic, trip-only circuit breakers in accordance with manufacturer's instructions.

CONDUIT AND FITTINGS:

General:

Conduit system shall be carefully planned with proper attention to details before starting the work.

Do not install crushed or deformed raceways. Replace any raceway that has been damaged after installation.

Raceways that are installed so as to form a moisture trap are not allowed.

Prevent plaster, dirt, or trash from lodging in raceways, boxes, fittings, and equipment during the course of construction. Clear clogged raceways of obstructions.

All conduit runs shall be made parallel to or perpendicular to the lines of the building.

Secure conduits entering cabinets, pull boxes or outlet boxes with galvanized locknuts and bushings, on both sides of box wall.

Applications:

Exposed Exterior: Type RGS.

Concrete Embedded: Type PVC.

Direct Buried: Type PVC.

Vertical Runs Through Slab: Convert PVC conduit to RGS wrapped with plastic tape.

PVC Bends: Bends in PVC runs shall be incorporated using RGS.

Final Connection to Motors:

Conduit Size 4 Inches or Less: 18-inch minimum, 60-inch maximum length of flexible liquid-tight metal conduit.

Penetrations:

Conduits penetrating fire-rated walls shall be sealed with a compound approved by UL and INEEL, and appropriate to the fire rating of the wall.

Flash and counterflash conduits penetrating roofing membrane.

Seal penetrations with oakum or expandable plastic compound.

Provide sleeves and chases where conduits pass through floors or walls. Finish to match adjacent surfaces.

Provide escutcheon plates where exposed conduits pass through walls, floors or ceilings.

Conduits from the combined sump area penetrating the evaporation building walls shall be sealed with a compound approved by UL and INEEL, and appropriate for conduits in hazardous areas entering non-hazardous areas.

Slab-On-Grade or Direct Buried:

Install horizontal runs below floor slab. Horizontal runs within slab shall not be permitted.

Field wrap RGS conduit and joints installed below slab or direct buried with 0.010-inch thick pipe wrapping plastic tape applied with a 50 percent overlay, or factory apply a plastic resin, epoxy, or coal-tar coating system.

Exposed Raceways:

Install parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings.

Changes in Direction of Runs:

Make with symmetrical bends or cast metal fittings.

Bends and offsets shall be made with a hickey or conduit bending machine.

Supports:

Provide pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps with retainers, or ceiling trapeze.

Install suitable braces for conduit, junction boxes, light fixtures and other electrical equipment as needed for seismic support.

Securely and rigidly fasten in place.

Maximum Interval: 10 feet.

CONDUCTORS:

Conduit system shall be complete prior to drawing conductors.

Lubricate prior to drawing into conduit. Lubrication type shall be as approved by conductor manufacturer.

Connections: Pressure type solderless, complete with insulator and security ring.

Control Circuits:

Where multiple units perform parallel operations, do not group all devices on same branch circuit.

Do not exceed the ampacity of the branch circuit, or 12 amperes continuous.

Terminate feeder and interconnecting conductors between panel mounted equipment and external equipment at numbered terminal blocks.

Identification:

Where two or more conduits run to a single outlet box, color code each circuit as a guide in making connections.

Carry colors continuously throughout the system.

Do not install multiwire branch circuits that share a common neutral.

Colors:

Neutral (Grounded Current Carrying Conductor): White (120/208V); Gray (277/480V).

Ungrounded Current Carrying Conductor:

120/208-Volt System: Black (Phase A), red (Phase B), or blue (Phase C).

277/480-Volt System: Yellow (Phase A), orange (Phase B), brown (Phase C).

Ground Wire: Green.

DC System Conductors: DC^{+} (red), DC^{-} (black).

TERMINAL BLOCKS:

Install for termination of all control circuits leaving or entering equipment, panels, or boxes.

LUMINAIRES:

Install in accordance with manufacturer's recommendations.

Install plumb and true.

Provide swivel type hangers and canopies to match pendant mounted fixtures.

Furnish all lamps and clean the reflectors, the diffusers, and the lamps before closing up the fixtures.

BOXES:

Support to the structure, independent of conduit attachment.

Boxes installed belowgrade shall be installed flush with finished grade.

Boxes and covers in paved areas, roadways, or walkways shall be suitable for weights to which they may be subjected.

Box Extensions: Not permitted.

Corrosive Areas: Boxes shall be applicable for location and corrosive atmosphere present.

COVER PLATES:

Shall fit tightly to box.

Shall not extend beyond sides of box on surface mounted boxes, unless covers have no sharp corners or edges.

TRENCH BACKFILL:

In accordance with Section 02320, TRENCH BACKFILL.

PROTECTION FOLLOWING INSTALLATION:

Protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation.

Cap conduit runs during construction with manufactured seals.

Close openings in boxes or equipment during construction.

Energize space heaters furnished with equipment.

TESTING:

Circuit Balance:

Confirm the balance of electrical load between phases on panelboards and motor control centers after installation.

Voltage Testing:

When installation is complete and facility is in operation, check voltage at point of termination of electric supply system to project.

Check voltage amplitude and balance between phases for loaded and unloaded conditions.

Record supply voltage for 24 continuous hours. If unbalance exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded conditions more than plus or minus 4 percent of nominal, make written request to Operating Contractor to correct condition.

Equipment Line Current:

Check line current in each phase for each piece of equipment.

If electric utility makes adjustments to supply voltage magnitude or balance, make line current check after adjustments are made.

Inspection of Low Voltage Cables, 600 Volts Maximum:

Inspect each individual exposed power cable for physical damage, proper connections in accordance with single-line diagram and cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.

Inspect shielded instrumentation cables for proper shield grounding, terminations, and circuit identification

Inspect control cables for proper termination, and proper circuit identification.

Electrical Tests for Conductors:

Prior to final connection and energizing of power and control circuits, conduct an insulation resistance test to determine insulation integrity

Utilize 1,000V dc megohmmeter for 600-volt insulated conductors and 500V dc megohmmeter for 300-volt insulated conductors.

Test each conductor with respect to ground and to adjacent conductors per IEEE 118 procedures for 1 minute.

Evaluate ohmic values by comparison with conductors of same length and type.

Investigate values less than 50 megohms.

Continuity test by ohmmeter method to ensure proper cable connections.

Provide in spreadsheet format results of all inspection and testing for all cables. Conduit and cable schedule attached as supplement to this specification will be provided to Contractor in electronic format upon request.

Ground Electrode Test:

Inspect grounding connections prior to any backfill of cables.

Utilize Fall-of-Potential test in accordance with IEEE 81, Section 8.2.1.5, to measure ground electrode system's resistance.

Maximum ground electrode resistance shall be 3 ohms. Add additional ground rods to achieve maximum 3 ohms resistance.

SUPPLEMENTS:

The supplements listed below, following "END OF SECTION," are a part of this Specification.

Supplement 1—Luminaire Schedule.

Supplement 2—Panel Schedule.

Supplement 3—Conduit and Cable Schedule.

END OF SECTION 16005

LUMINAIRE SCHEDULE						
Type	**Voltage**	**Description**	**Manufacturer**	**Catalogue No.**	**Lamp**	**Mounting Type**
1	120	Heavy Duty Industrial 4-foot Fluorescent Fixture with 2 Lamps with Low Temp Starting Ballasts.	Holophane	7200-4-12-LT Fluorescent Prismatite or equal.	2- 40W R.S. T12, 0° F starting (48″)	Pendant with Chains
2	120	Emergency Tungsten Light NiCaD Battery Operated.	Holophane	C1-6N-25-W-WCHY-2 Cortez A1	2-12 Watt 6-Volt Halogen	Wall Mount
3	120	WallPack Wall Mount HPS with Integral Photocell.	Holophane	WallPack WL2K-070HP-12-BK—F1-LAMP-PC	1-70W HPS	Wall Mount

Project Title: ICDF Landfill and Evaporation Pond RD/CWP Work Plan – Tier II
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Revision Number: 1

PANEL: Evaporation Pond(s) Crest Pad Building LP-CD-2180

VOLTAGE: **208/120** | PANEL BUS: **100** AMPS | SERVICE RATED: **NO**
PHASE, WIRES: **3, 4** | MAIN: **60** BREAKER | NEUTRAL: **BONDED**
SCR (AMPS): **10,000** | 125% OF MAX BUS LOAD: **30** AMPS | MOUNTING: **IN MCC**
SOURCE: **MCC** | TOTAL LOAD: **7.6** KVA | FEED: **TOP/BOTTOM**

DESCRIPTION	KVA	CB	CKT	A	B	C	CKT	CB	KVA	DESCRIPTION
Interior Lighting	0.57	20/1	1	13.1			2	20/3	1.00	**Air Conditioning Unit**
Exterior Lighting	0.70	20/1	3		14.2		4	-	1.00	**Air Conditioning Unit**
Control Panel	1.50	20/1	5			20.8	6	-	1.00	**Air Conditioning Unit**
Fire Alarm Panel	0.72	20/1	7	6.0			8	20/1	0.00	Spare
Voice Pager	0.42	20/1	9		3.5		10	20/1	0.00	Spare
Maintenance Outlets	0.36	20/1	11			3.0	12	20/1	0.00	Spare
Maintenance Outlets	0.36	20/1	13	3.0			14	20/1	0.00	Spare
Spare	0.00	20/1	15		0.0		16	20/1	0.00	Spare
Spare	0.00	20/1	17			0.0	18	20/1	0.00	Spare
			TOTALS	**22.1**	**17.7**	**23.8**	AMPS			

PANEL: Landfill Crest Pad Building LP-CD-2182

VOLTAGE: **208/120** | PANEL BUS: **100** AMPS | SERVICE RATED: **NO**
PHASE, WIRES: **3, 4** | MAIN: **60** BREAKER | NEUTRAL: **BONDED**
SCR (AMPS): **10,000** | 125% OF MAX BUS LOAD: **30** AMPS | MOUNTING: **IN MCC**
SOURCE: **MCC** | TOTAL LOAD: **7.7** KVA | FEED: **TOP/BOTTOM**

DESCRIPTION	KVA	CB	CKT	A	B	C	CKT	CB	KVA	DESCRIPTION
Interior Lighting	0.61	20/1	1	13.4			2	20/3	1.00	**Air Conditioning Unit**
Exterior Lighting	0.70	20/1	3		14.2		4	-	1.00	**Air Conditioning Unit**
Control Panel	1.50	20/1	5			20.8	6	-	1.00	**Air Conditioning Unit**
Fire Alarm Panel	0.72	20/1	7	6.0			8	20/1	0.00	Spare
Voice Pager	0.42	20/1	9		3.5		10	20/1	0.00	Spare
Maintenance Outlets	0.36	20/1	11			3.0	12	20/1	0.00	Spare
Maintenance Outlets	0.36	20/1	13	3.0			14	20/1	0.00	Spare
Spare	0.00	20/1	15		0.0		16	20/1	0.00	Spare
Spare	0.00	20/1	17			0.0	18	20/1	0.00	Spare
			TOTALS	**22.4**	**17.7**	**23.8**	AMPS			

CONDUIT AND CABLE SCHEDULE

CONDUIT ID	EQUIPMENT NAME	FROM	TO	VIA	CONDUIT SIZE	CONDUIT TYPE	CABLE FILL	CABLE TYPE	VOLTAGE	DRAWING NUMBER	REMARKS
C001	MCC-CD-2181	INEEL POWER MANHOLE	LANDFILL CREST PAD BUILDING MCC	BELOW GRADE	2"	PVC	3#2, 1#4G	XHHW-2	480V ac	E-201	
C002	MCC-CD-2180	INEEL POWER MANHOLE	EVAPORATION POND(S) CREST PAD BUILDING MCC	BELOW GRADE	2"	PVC	3#2, 1#4G	XHHW-2	480V ac	E-201	
C003	CP-CD-950	INEEL COMMUNICATION HANDHOLE	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	5"	PVC				E-201	Multi-Cell Raceway
C004	CP-CD-951	INEEL COMMUNICATION HANDHOLE	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	5"	PVC				E-201	Multi-Cell Raceway
C005	FPCP-1	INEEL COMMUNICATION HANDHOLE	LANDFILL CREST PAD BUILDING FIRE PANEL	BELOW GRADE	2"	PVC				E-201	Install pull wire
C006	FPCP-2	INEEL COMMUNICATION HANDHOLE	EVAPORATION POND(S) CREST PAD BUILDING FIRE PANEL	BELOW GRADE	2"	PVC				E-201	Install pull wire
C007	ECS-CD-1799	INEEL COMMUNICATION HANDHOLE	LANDFILL CREST PAD BUILDING VOICE PAGER	BELOW GRADE	2"	PVC				E-201	Install pull wire
C008	ECS-CD-1798	INEEL COMMUNICATION HANDHOLE	EVAPORATION POND(S) CREST PAD BUILDING VOICE PAGER	BELOW GRADE	2"	PVC				E-201	Install pull wire
C009	DSW-CD-203-1	LANDFILL CREST PAD BUILDING MCC	LANDFILL LCRS HIGH FLOW PUMP DISCONNECT	BELOW GRADE	3/4"	RGS	3#12, 1#12G	THWN	480V ac	E-202	Combine cables
C010	DSW-CD-203-2	LANDFILL CREST PAD BUILDING MCC	LANDFILL LCRS LOW FLOW PUMP DISCONNECT	BELOW GRADE	3/4"	RGS	3#12, 1#12G	THWN	480V ac	E-202	
C011	DSW-CD-204	LANDFILL CREST PAD BUILDING MCC	LANDFILL LDRS PUMP DISCONNECT	BELOW GRADE	3/4"	RGS	3#12, 1#12G	THWN	480V ac	E-202	Combine cables
C012	DSW-CD-208	LANDFILL CREST PAD BUILDING MCC	LANDFILL SLDRS PUMP DISCONNECT	BELOW GRADE	3/4"	RGS	3#12, 1#12G	THWN	480V ac	E-202	
C013	UH-CD-1799	LANDFILL CREST PAD BUILDING MCC	LANDFILL CREST PAD BUILDING UNIT HEATER	SURFACE MOUNT	3/4"	RGS	3#10, 1#10G	THWN	480V ac	E-202	
C014	AC-CD-251	LANDFILL CREST PAD BUILDING MCC	LANDFILL CREST PAD BUILDING AIR CONDITIONER	SURFACE MOUNT	3/4"	RGS	4#12, 1#12G	THWN	208V ac	E-202	
C015	D-CD-750	LANDFILL CREST PAD BUILDING MCC	LANDFILL CREST PAD BUILDING AIR CONDITIONER DAMPER MOTOR	SURFACE MOUNT	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C016	CP-CD-950	LANDFILL CREST PAD BUILDING MCC	LANDFILL CREST PAD BUILDING CONTROL PANEL	SURFACE MOUNT	1 1/4"	RGS	24#14, 1#14G	THWN	120V ac	E-202	
C017	CP-CD-950	LANDFILL CREST PAD BUILDING LIGHTING PANEL	LANDFILL CREST PAD BUILDING CONTROL PANEL	SURFACE MOUNT	3/4"	RGS	2#10, 1#10G	THWN	120V ac	E-202	
C018	ECS-CD-1799	LANDFILL CREST PAD BUILDING LIGHTING PANEL	LANDFILL CREST PAD BUILDING VOICE PAGER	BELOW GRADE	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C019	FPCP-1	LANDFILL CREST PAD BUILDING LIGHTING PANEL	LANDFILL CREST PAD BUILDING FIRE PANEL	BELOW GRADE	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C020	-	LANDFILL CREST PAD BUILDING LIGHTING PANEL	LANDFILL CREST PAD BUILDING INTERIOR LIGHTING	SURFACE MOUNT	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C021	-	LANDFILL CREST PAD BUILDING LIGHTING PANEL	LANDFILL CREST PAD BUILDING EXTERIOR LIGHTING	SURFACE MOUNT	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C022	-	LANDFILL CREST PAD BUILDING LIGHTING PANEL	LANDFILL CREST PAD BUILDING RECEPTACLES	BELOW GRADE	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C023	-	LANDFILL CREST PAD BUILDING LIGHTING PANEL	LANDFILL CREST PAD BUILDING RECEPTACLES	BELOW GRADE	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C024	P-CD-205	LANDFILL CREST PAD BUILDING MCC	LANDFILL CREST PAD BUILDING SUMP PUMP	BELOW GRADE	3/4"	RGS	3#12, 1#12G	THWN	480V ac	E-202	
C025	LCP-CD-941	LANDFILL CREST PAD BUILDING SUMP PANEL	LANDFILL CREST PAD BUILDING MCC	BELOW GRADE	3/4"	RGS	8#14, 1#14G	THWN	24V dc	E-202	
C026	LCP-CD-941	LANDFILL CREST PAD BUILDING SUMP PANEL	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	6#14, 1#14G	THWN	24V dc	E-202	
C027	FE-CD-203-1	LANDFILL LCRS HIGH FLOW PUMP PROPELLER ELEMENT	LANDFILL LCRS HIGH FLOW PUMP PROPELLER TRANSMITTER	SURFACE MOUNT	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C028	FE-CD-203-2	LANDFILL LCRS LOW FLOW PUMP PROPELLER ELEMENT	LANDFILL LCRS LOW FLOW PUMP PROPELLER TRANSMITTER	SURFACE MOUNT	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C029	FE-CD-204	LANDFILL LDRS PUMP FLOW PROPELLER ELEMENT	LANDFILL LDRS PUMP FLOW PROPELLER TRANSMITTER	SURFACE MOUNT	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C030	FE-CD-208	LANDFILL SLDRS PUMP FLOW PROPELLER ELEMENT	LANDFILL SLDRS PUMP FLOW PROPELLER TRANSMITTER	SURFACE MOUNT	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C031	FT-CD-203-1	LANDFILL LCRS HIGH FLOW PUMP PROPELLER TRANSMITTER	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C032	FT-CD-203-2	LANDFILL LCRS LOW FLOW PUMP PROPELLER TRANSMITTER	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	Combine cables
C033	FT-CD-204	LANDFILL LDRS PUMP FLOW PROPELLER TRANSMITTER	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C034	FT-CD-208	LANDFILL SLDRS PUMP FLOW PROPELLER TRANSMITTER	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C035	FT-CD-203-1	LANDFILL LCRS HIGH FLOW PUMP PROPELLER TRANSMITTER	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	
C036	FT-CD-203-2	LANDFILL LCRS LOW FLOW PUMP PROPELLER TRANSMITTER	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	Combine cables
C037	FT-CD-204	LANDFILL LDRS PUMP FLOW PROPELLER TRANSMITTER	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	
C038	FT-CD-208	LANDFILL SLDRS PUMP FLOW PROPELLER TRANSMITTER	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	
C039	P-CD-203-1/LT-CD-103-1	LANDFILL LCRS SUBMERSIBLE PUMP AND PRESSURE TRANSDUCER	LANDFILL LCRS SUBMERSIBLE PUMP DISCONNECTECT AND TJB	BELOW GRADE	-	-	MFC	PVC/TSP	480V/24V dc	E-202	Manufacturer cable
C040	P-CD-203-2	LANDFILL LCRS SUBMERSIBLE PUMP	LANDFILL LCRS SUBMERSIBLE PUMP DISCONNECTECT	BELOW GRADE	-	-	MFC	PVC/TSP	480V	E-202	Manufacturer cable
C041	P-CD-204/LT-CD-104	LANDFILL LCRS SUBMERSIBLE LOW FLOW PUMP	LANDFILL LCRS SUBMERSIBLE PUMP DISCONNECT AND TJB	BELOW GRADE	-	-	MFC	PVC/TSP	480V/24V dc	E-202	Manufacturer cable
C042	LT-CD-103	LANDFILL LCRS SUBMERSIBLE PRESSURE TRANSDUCER TJB	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C043	LT-CD-104	LANDFILL LDRS SUBMERSIBLE PRESSURE TRANSDUCER TJB	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	Combine cables
C044	LT-CD-108	LANDFILL SLDRS SUBMERSIBLE PRESSURE TRANSDUCER TJB	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C045	TT-CD-1799	LANDFILL CREST PAD BUILDING TEMPERATURE TRANSMITTER	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C046	P-CD-208/LT-CD-108	LANDFILL SLDRS SUBMERSIBLE PUMP AND PRESSURE TRANSDUCER	LANDFILL SLDRS SUBMERSIBLE PUMP DISCONNECT AND TJB	BELOW GRADE	-	-	MFC	PVC/TSP	480V/24V dc	E-202	Manufacturer cable
C047	FPCP-1	LANDFILL CREST PAD BUILDING FIRE ALARM PANEL	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	PVC/TSP	24V dc	E-202	
C048	ZS-CD-1799	LANDFILL CREST PAD BUILDING DOOR INTRUSION SWITCH	LANDFILL CREST PAD BUILDING CONTROL PANEL	SURFACE MOUNT	3/4"	RGS	2#14, 1#14G	PVC/TSP	24V dc	E-202	
C049	YA-CD-1799-1	LANDFILL CREST PAD BUILDING GENERAL ALARM LIGHT	LANDFILL CREST PAD BUILDING CONTROL PANEL	SURFACE MOUNT	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	
C050	ECS-CD-1799	LANDFILL CREST PAD BUILDING VOICE PAGER	LANDFILL CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	4#14, 1#14G	PVC/TSP	24V dc	E-202	
C051	DSW-CD-201	EVAPORATION POND(S) CREST PAD BUILDING MCC	EVAPORATION POND(S) LDRS PUMP DISCONNECT	BELOW GRADE	3/4"	RGS	3#12, 1#12G	THWN	480V ac	E-202	
C052	UH-CD-1798	EVAPORATION POND(S) CREST PAD BUILDING MCC	EVAPORATION POND(S) CREST PAD BUILDING UNIT HEATER	SURFACE MOUNT	3/4"	RGS	3#12, 1#12G	THWN	480V ac	E-202	
C053	P-CD-207	EVAPORATION POND(S) CREST PAD BUILDING MCC	EVAPORATION POND(S) COMBINED SUMP PUMP	BELOW GROUND	3/4"	RGS	3#12, 1#12G	THWN	480V ac	E-201	Provide conduit seals.
C054	CP-CD-951	EVAPORATION POND(S) CREST PAD BUILDING MCC	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	SURFACE MOUNT	1 1/4"	RGS	18#14, 1#14G	THWN	120V ac	E-202	
C055	AC-CD-250	EVAPORATION POND(S) CREST PAD BUILDING MCC	EVAPORATION POND(S) CREST PAD BUILDING AIR CONDITIONER	SURFACE MOUNT	3/4"	RGS	4#12, 1#12G	THWN	208V ac	E-202	
C056	D-CD-751	EVAPORATION POND(S) CREST PAD BUILDING MCC	EVAPORATION POND(S) CREST PAD BUILDING AIR CONDITIONER DAMPER MOTOR	SURFACE MOUNT	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	

CONDUIT AND CABLE SCHEDULE

CONDUIT ID	EQUIPMENT NAME	FROM	TO	VIA	CONDUIT SIZE	CONDUIT TYPE	CABLE FILL	CABLE TYPE	VOLTAGE	DRAWING NUMBER	REMARKS
C057	CP-CD-951	EVAPORATION POND(S) CREST PAD BUILDING LIGHTING PANEL	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	SURFACE MOUNT	3/4"	RGS	2#10, 1#10G	THWN	120V ac	E-202	
C058	ECS-CD-1798	EVAPORATION POND(S) CREST PAD BUILDING LIGHTING PANEL	EVAPORATION POND(S) CREST PAD BUILDING VOICE PAGER	BELOW GRADE	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C059	FPCP-2	EVAPORATION POND(S) CREST PAD BUILDING LIGHTING PANEL	EVAPORATION POND(S) CREST PAD BUILDING FIRE PANEL	BELOW GRADE	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C060		EVAPORATION POND(S) CREST PAD BUILDING LIGHTING PANEL	EVAPORATION POND(S) CREST PAD BUILDING INTERIOR LIGHTING	SURFACE MOUNT	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C061		EVAPORATION POND(S) CREST PAD BUILDING LIGHTING PANEL	EVAPORATION POND(S) CREST PAD BUILDING EXTERIOR LIGHTING	SURFACE MOUNT	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C062		EVAPORATION POND(S) CREST PAD BUILDING LIGHTING PANEL	EVAPORATION POND(S) CREST PAD BUILDING RECEPTACLES	BELOW GRADE	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C063		EVAPORATION POND(S) CREST PAD BUILDING LIGHTING PANEL	EVAPORATION POND(S) CREST PAD BUILDING RECEPTACLES	BELOW GRADE	3/4"	RGS	2#12, 1#12G	THWN	120V ac	E-202	
C064	LCP-CD-942	EVAPORATION POND(S) CREST PAD BUILDING SUMP PANEL	EVAPORATION POND(S) CREST PAD BUILDING MCC	BELOW GRADE	3/4"	RGS	8#14, 1#14G	THWN	24V dc	E-202	
C065	LCP-CD-942	EVAPORATION POND(S) CREST PAD BUILDING SUMP PANEL	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	6#14, 1#14G	THWN	24V dc	E-202	
C066	LCP-CD-943	EVAPORATION POND(S) COMBINED SUMP INTRINSIC SAFETY PANEL	EVAPORATION POND(S) CREST PAD BUILDING MCC	BELOW GRADE	3/4"	RGS	4#14, 1#14G	THWN	24V dc	E-202	
C067	LCP-CD-943	EVAPORATION POND(S) COMBINED SUMP INTRINSIC SAFETY PANEL	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	8#14, 1#14G	THWN	24V dc	E-202	
C068	LT-CD-101	EVAPORATION WEST POND(S) LDRS LEVEL TRANSDUCER	EVAPORATION WEST POND(S) LDRS LEVEL TRANSDUCER TJB	BELOW GRADE	-	-	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C069	LT-CD-102	EVAPORATION EAST POND(S) LDRS LEVEL TRANSDUCER	EVAPORATION EAST POND(S) LDRS LEVEL TRANSDUCER TJB	BELOW GRADE	-	-	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C070	LT-CD-101	EVAPORATION EAST POND(S) LDRS LEVEL TRANSDUCER TJB	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	Combine cables
C071	LT-CD-102	EVAPORATION WEST POND(S) LDRS LEVEL TRANSDUCER TJB	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C072	FE-CD-207	EVAPORATION POND(S) COMBINED SUMP FLOW PROPELLER ELEMENT	EVAPORATION POND(S) COMBINED SUMP FLOW PROPELLER TRANSMITTER	BELOW GRADE	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C073	FE-CD-327	EVAPORATION POND(S) TRUCK LOADING/UNLOADING FLOW PROPELLER ELEMENT	EVAPORATION POND(S) TRUCK LOADING/UNLOADING FLOW PROPELLER TRANSMITTER	BELOW GRADE	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C074	FE-CD-330	EVAPORATION POND(S) WASTEWATER FROM SSSTF FLOW PROPELLER ELEMENT	EVAPORATION POND(S) WASTEWATER FROM SSSTF FLOW PROPELLER TRANSMITTER	BELOW GRADE	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C075	FT-CD-207	EVAPORATION POND(S) COMBINED SUMP FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C076	FT-CD-327	EVAPORATION POND(S) TRUCK LOADING/UNLOADING FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	Combine cables
C077	FT-CD-330	EVAPORATION POND(S) WASTEWATER FROM SSSTF FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C078	FT-CD-207	EVAPORATION POND(S) COMBINED SUMP FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	
C079	FT-CD-327	EVAPORATION POND(S) TRUCK LOADING/UNLOADING FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	Combine cables
C080	FT-CD-330	EVAPORATION POND(S) WASTEWATER FROM SSSTF FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	
C081	TT-CD-1798	EVAPORATION POND(S) CREST PAD BUILDING TEMPERATURE TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C082	P-CD-201	EVAPORATION POND(S) LDRS SUBMERSIBLE PUMP	EVAPORATION POND(S) LDRS PUMP DISCONNECT	BELOW GRADE	-	-	MFC	PVC/TSP	480V	E-202	Manufacturer cable
C083	P-CD-202	EVAPORATION POND(S) LDRS SUBMERSIBLE PUMP	EVAPORATION POND(S) LDRS PUMP DISCONNECT	BELOW GRADE	-	-	MFC	PVC/TSP	480V	E-202	Manufacturer cable
C084	LSH-CD-499	LANDFILL LEACHATE TRANSMISSION LINE LEAK DETECTION LEVEL FLOAT	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	24V dc	E-201	
C085	ZS-CD-1798	EVAPORATION POND(S) CREST PAD BUILDING DOOR INTRUSION SWITCH	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	SURFACE MOUNT	3/4"	RGS	2#14, 1#14G	THWN	24V dc	E-202	
C086	LSHH/H/L-CD-107	EVAPORATION POND(S) COMBINED SUMP LEVEL FLOATS	EVAPORATION POND(S) COMBINED SUMP INTRINSIC SAFETY PANEL	BELOW GRADE	1 1/4"	RGS	MFC		24V dc	E-201	Manufacturer cable. Provide conduit seals.
C087	FPCP-2	EVAPORATION POND(S) CREST PAD BUILDING FIRE ALARM PANEL	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	4#14, 1#14G	THWN	24V dc	E-202	
C088	LSH-CD-109	SSSTF LINE VARV HIGH LEVEL FLOAT	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	24V dc	E-201	Manufacturer cable
C089	YA-CD-1798-1	EVAPORATION POND(S) CREST PAD BUILDING GENERAL ALARM LIGHT	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	SURFACE MOUNT	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	
C090	ECS-CD-1798	EVAPORATION POND(S) CREST PAD BUILDING VOICE PAGER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	SURFACE MOUNT	3/4"	RGS	4#14, 1#14G	THWN	24V dc	E-202	
C091		EVAPORATION POND(S) CREST PAD BUILDING GENERATOR RECEPTACLE	EVAPORATION POND(S) CREST PAD BUILDING MCC	BELOW GRADE	1"	RGS	3#4, 1#8G	THWN	480V ac	E-202	
C092	DSW-CD-202	EVAPORATION POND(S) CREST PAD BUILDING MCC	EVAPORATION POND(S) LDRS PUMP DISCONNECT	BELOW GRADE	3/4"	RGS	3#12, 1#12G	THWN	480V ac	E-202	
C093		LANDFILL CREST PAD BUILDING GENERATOR RECEPTACLE	LANDFILL CREST PAD BUILDING MCC	BELOW GRADE	1"	RGS	3#4, 1#8G	THWN	480V ac	E-202	
C094	DSW-CD-209	EVAPORATION POND(S) CREST PAD BUILDING MCC	EVAPORATION POND(S) TRANSFER PUMP DISCONNECT	BELOW GRADE	3/4"	RGS	3#12, 1#12G	THWN	480V ac	E-202	
C095	FE-CD-210	RAW WATER FLOW PROPELLER ELEMENT	RAW WATER COMBINED SUMP FLOW PROPELLER TRANSMITTER	BELOW GRADE	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C096	FE-CD-201	EVAPORATION POND(S) LEAK DETECTION FLOW PROPELLER ELEMENT	EVAPORATION POND(S) LEAK DETECTION FLOW PROPELLER TRANSMITTER	BELOW GRADE	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C097	FE-CD-202	EVAPORATION POND(S) LEAK DETECTION FLOW PROPELLER ELEMENT	EVAPORATION POND(S) LEAK DETECTION FLOW PROPELLER TRANSMITTER	BELOW GRADE	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C098	FT-CD-210	RAW WATER FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C099	FT-CD-201	EVAPORATION POND(S) LEAK DETECTION FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	Combine cables
C100	FT-CD-202	EVAPORATION POND(S) LEAK DETECTION FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C101	FT-CD-210	RAW WATER FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	
C102	FT-CD-201	EVAPORATION POND(S) LEAK DETECTION FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	Combine cables
C103	FT-CD-202	EVAPORATION POND(S) LEAK DETECTION FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	
C104	FE-CD-211	TRUCK LOADING FLOW PROPELLER ELEMENT	TRUCK LOADING FLOW PROPELLER TRANSMITTER	BELOW GRADE	3/4"	RGS	MFC	PVC/TSP	24V dc	E-202	Manufacturer cable
C105	FT-CD-211	TRUCK LOADING FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	1-TYPE 3	PVC/TSP	24V dc	E-202	
C106	FT-CD-211	TRUCK LOADING FLOW PROPELLER TRANSMITTER	EVAPORATION POND(S) CREST PAD BUILDING CONTROL PANEL	BELOW GRADE	3/4"	RGS	2#14, 1#14G	THWN	120V ac	E-202	

SECTION 16480--LOW VOLTAGE MOTOR CONTROL

PART 1--GENERAL

UL COMPLIANCE:

Products manufactured within scope of Underwriters Laboratories shall conform to UL Standards and have an applied UL Listing Mark.

ELECTRICAL DESCRIPTION OF WORK:

Provide the following 480-volt, three-phase, three-wire with ground, 600-amp service rated motor control centers in accordance with this Specification and Contract Drawings:

MCC-CD-2179 to be installed inside the INEEL CERCLA Evaporation Ponds Crest Pad Building.

MCC-CD-2181 to be installed inside the INEEL CERCLA Landfill Crest Pad Building.

MCC-CD-2179 center shall provided with the following minimum features in accordance with this Specification and Contract Drawings:

Main Breaker.

Phase Loss and Reversal Protection Relay.

Generator Breaker.

Generator Interlock Key.

Volt and Current Meters.

Lighting Panel LP-CD-2180.

Lighting Panel Transformer XFR-CD-8553.

ECP Control Section (Feed from lighting panel)

NEMA 1 Size Motor Starters (four each).

NEMA Breakers.

Three Sections.

MCC-CD-2181 center shall provided with the following minimum features in accordance with this Specification and Contract Drawings:

Main Breaker.

Phase Loss and Reversal Protection Relay.

Generator Breaker.

Generator Interlock Key.

Volt and Current Meters.

Lighting Panel LP-CD-2182.

Lighting Panel Transformer XFR-CD-8552.

ECP Control Section (Feed from lighting panel)

NEMA 1 Size Motor Starters (five each).

NEMA Breakers.

Three Sections.

PACKING AND SHIPPING:

Shipping Splits: Established by Construction Subcontractor to facilitate ingress of equipment to final installation location within the building.

PART 2--PRODUCTS

MANUFACTURERS:

Allen-Bradley.

Cutler-Hammer/Westinghouse.

Square D.

MOTOR CONTROL:

General:

Like Items of Equipment: End product and responsibility of one manufacturer.

Make adjustments as necessary to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors actually provided under this Contract.

Controllers: NEMA ICS 2, Class A.

Thermal Overload Protection:

Inverse-time-limit characteristic.

Heater: Class 10, bimetallic overload, adjustable trip.

Relay Trip: Standard, Class 20.

Manual reset.

Provide in each ungrounded phase.

Mount within starter unit.

Control Transformer:

Two winding, 120-volt secondary, primary voltage to suit.

Two current-limiting fuses for primary circuit.

One fuse in secondary circuit.

Mount within starter unit.

Suitable for use with 75 degrees C copper wire at full NFPA 70, 75 degrees C ampacity.

Lifting lugs on all equipment and devices weighing over 100 pounds.

Operating Conditions:

Ambient Temperature: Maximum 40 degrees C.

Equipment to be fully rated without any derating for operating conditions listed in Section 16005, ELECTRICAL.

Enclosures: In accordance with NEMA 250 and ANSI C57.12.28.

Equipment Finish:

Electrocoating process applied over a rust-inhibiting phosphated base coating.

Exterior Color: Manufacturer's standard.

Manually Operated Starter, Fractional Horsepower:

Rating: 16 amperes continuous at 277 volts maximum, or horsepower rated for the voltage and horsepower of the load served.

Single-phase, nonreversing, full voltage with overload protection.

Toggle operated.

Enclosure: Reference Section 16005, ELECTRICAL, Article ENVIRONMENTAL CONDITIONS.

Neon Light: Red.

Handle guard/lock-off attachment.

Combination Full-Voltage, Magnetic Starter:

Rating: Hp rated at 600 volts, UL labeled for 42,000 amperes fault current withstand capacity with overload protection.

Three-phase, nonreversing, full voltage.

Control: HAND/OFF/AUTO selector switch.

Disconnect Type: Motor circuit protector.

Enclosure: Reference Section 16005, ELECTRICAL, Article ENVIRONMENTAL CONDITIONS.

Pilot Lights: Red—ON and Green—OFF.

Padlockable operating handle.

MOTOR CONTROL CENTERS:

General:

Motor Control Center to be manufactured and provided as a complete UL-approved assembly that includes the following major components specified under this section and Section 16005, ELECTRICAL:

Motor starters.

Feeder and main breaker.

Power monitoring.

Lighting and power distribution panelboard.

Lighting and power distribution stepdown transformer.

In accordance with NEMA ICS 2 and UL 845.

Voltage Rating: 600 volts.

Short Circuit Rating: 42,000 minimum amperes rms symmetrical for entire motor control center as a complete assembly.

All controllers, main and branch circuit breakers, wire connections, and other devices to be front mounted and accessible unless otherwise noted.

NEMA ICS 2, Section 322.08.

Class: I.

Type: B.

Wire remote control and signal circuits to separate terminal board in each motor starter compartment.

Enclosure:

Type: NEMA 250 Type 12 unless otherwise rated.

Vertical Section Dimensions: 90 inches high, 20 inches wide, 20 inches deep.

Construction:

Sheet steel reinforced with channel or angle irons.

Butt sections flush, end-to-end against similar section without bolts, nuts, or cover plates causing interference.

Removable top cover plates and bottom cover plates.

Section Mounting: Removable formed-steel channel sills and lifting angles to meet specified seismic requirements.

Horizontal Wiring Compartments: Accessible from front, full width, top and bottom.

Vertical Wiring Compartment: Full height, isolated from unit starters with separate door.

Unit Compartment: Individual compartments separated by steel barriers for each starter, feeder, or other unit capable of being wired from front without unit removal.

Compartment Doors: Separate hinged doors for each starter, feeder, or other unit.

Door Interlocking: Interlock starter and feeder doors mechanically so doors cannot be opened with unit energized. Provide defeater mechanism to allow intentional access at any time.

External disconnect handles, padlockable in OFF position.

Cable Entrance: Incoming service enters from bottom; control and feeder circuits enter from top and bottom.

Bus:

Horizontal Power Bus:

Three-phase tin-plated, fully insulated, copper, entire width of control center, rated 600 amperes.

Construct to allow future extension of additional sections.

Pressure type solderless lugs for each incoming line cable.

Isolated from top horizontal wireway.

Provide Belleville washers on bus connection bolts.

Vertical Power Bus:

Three-phase tin-plated, fully insulated, copper, full height of section, rated 300 amperes.

Sandwich type bus insulation providing deadfront construction with starter units removed except for bus stab openings.

Insulated and isolated barrier complete with shutters.

Provide Belleville washers on bus connection bolts.

Ground Bus:

Copper, tin-plated, 33 percent minimum of phase bus ampacity, entire width of control center.

Provide Belleville washers on bus connection bolts.

Bus Bracing: 42,000 minimum amperes rms symmetrical.

Motor Controller Unit:

Provide indicated individual components and control devices including pushbuttons, selector switches, indicating lights, control relays, time delay relays, and elapsed time meters as specified in this section.

Construction:

Drawout combination type with stab connections for starters NEMA ICS, Size 4 and smaller.

Readily interchangeable with starters of similar size.

Pull-apart unit control wiring terminal boards on all units.

Starters:

NEMA ICS 2, Section 322.08 standard rating, except none smaller than NEMA ICS, Size 1.

Rating: Hp rated at 600 volts, UL labeled for 42,000 amperes fault current withstand capacity with overload protection.

Three-phase, nonreversing.

Disconnect Type: Motor circuit protector.

Combination Full Voltage, Magnetic Starter:

Control: ON/OFF/AUTO selector switch. As shown.

Pilot Lights: Red—ON; Green—OFF.

Padlockable operating handle when de-energized.

Unit door interlocked to prevent opening when disconnect is in closed position.

Mechanical interlocked to prevent placing disconnect in ON position when unit door is open.

Minimum Dimensions: 12 inches high by full section width, less vertical wireway.

Disconnecting Device:

In each starter, control circuit disconnect to de-energize circuits in unit which are not de-energized by starter power disconnect device.

Padlockable in OPEN position.

Circuit Breaker:

Meeting the requirements of NEMA AB1 and UL 489.

Molded case with manufacturer's recommended trip setting for maximum motor protection.

Thermal-magnetic trip or magnetic trip only as shown.

Tripping indicated by operating-handle position.

Interrupting capacity required for connection to system with short circuit capacity indicated.

Motor Overload Protection:

Temperature compensated, three-pole relay with bimetallic, adjustable trip elements.

Manual-reset overload relays.

Motor Thermal Protector Interface: Manual-reset interposing relay for connection to motor-mounted thermal protector system.

Control Unit:

Disconnecting Device: Capable of de-energizing external source control circuits in unit.

Control Devices: As indicated and as specified in Section 16005, ELECTRICAL.

Control Wiring:

Minimum wire size 14 AWG copper.

Permanent sleeve type markers with wire numbers applied to each end of wires.

Terminate current transformer leads on shorting type terminal blocks.

Feeder Unit and Main Protective Device:

Construction: As specified in paragraph Motor Controller Unit.

Incoming Service Feeder: Cable entering section at bottom.

Molded Case Circuit Breaker:

In accordance with NEMA AB1 and UL 489.

Main and Feeder protective device.

UL labeled as suitable for service entrance.

Thermal-magnetic trip and interrupting capacity required for connection to system with short circuit capacity indicated.

Shunt trip on main breaker only.

Indicate tripping by operating-handle position.

Suitable for use with 75 degrees C copper wire at full NEC 75 degrees C ampacity.

Phase Monitoring Relay: Three-phase monitoring relay to protect against phase loss and phase reversal.

Time Delay Relay:

Industrial Relay Rated: 600 volts, 5 amps continuous, (3,600 VA make, 360 VA break).

Solid-state electronic, field convertible ON/OFF delay.

One normally open and one normally closed contact (minimum).

Repeat accuracy plus or minus 2 percent.

Timer adjustment from 1 to 60 seconds, unless otherwise indicated on the Drawings.

Manufacturers and Products:

Allen-Bradley.

Square D Co.; Type F.

Cutler-Hammer.

Reset Timer:

Timing Method: Solid state with LCD display.

Mounting: Semi-flush, panel.

Contacts: 5-amp, 120-volt.

Manufacturers and Products:

Allen-Bradley; 700-HX.

Square D.

Elapsed Time Meter:

Drive: Synchronous motor.

Range: 0 to 99,999.9 hours, non-reset type.

Mounting: Semi-flush, panel, rectangular with screw terminals.

Manufacturers:

Veeder-Root.

Redington.

Magnetic Contactor:

UL listed.

Electrically operated, electrically held.

Main Contacts:

NEMA B600 contacts.

Electrically held.

Silver alloy with wiping action and arc quenchers.

NEMA Size 0 or 1 as required for the motor controller.

Three-pole.

Control: Two-wire.

One normally open and one normally closed auxiliary contact rated 10 amperes at 480 volts.

Manufacturers and Products:

Allen-Bradley.

Square D Co.; Type F.

Cutler-Hammer.

Pushbutton, Indicating Light and Selector Switches:

Contact Rating: NEMA ICS 2, Type A600.

Selector Switch Operating Lever: Standard.

Indicating Lights: Push-to-test, LED, full voltage.

Pushbutton Color:

ON or START: Black.

OFF or STOP: Red.

Pushbuttons and selector switches lockable in OFF position where indicated.

Legend Plate:

Material: Aluminum.

Engraving: 11 character/spaces on one line, 14 character/spaces on each of two lines, as required, indicating specific function.

Letter Height: 7/64 inch.

Manufacturers:

Allen-Bradley.

Square D Co.

Cutler-Hammer.

Nameplates:

Laminated plastic; white, engraved to black core.

Provide for each motor control center and each unit.

Engrave with inscription shown on single-line diagram.

Provide blank nameplates on spaces for future units.

Attach with stainless steel panhead screws on face of control center.

Factory Testing: NEMA ICS 1, Section 109, or UL 486A if not specified by the manufacturer.

PART 3--EXECUTION

INSTALLATION:

Install equipment in accordance with NEMA ICS 2.3, Submittal Drawings, and Manufacturer's Instructions and Recommendations.

Secure equipment to mounting pads with anchor bolts of sufficient size and number adequate for specified seismic conditions. Reference Section 13122, METAL BUILDING SYSTEMS, Part 2, Article DESIGN LOADS, for information on seismic loading. Install suitable braces from MCC to building structural members for seismic support.

Install equipment plumb and in longitudinal alignment with pad or wall.

Coordinate terminal connections with installation of secondary feeders.

Grout mounting channels into floor or mounting pads.

Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.

CIRCUIT BREAKERS (MAGNETIC-TRIP-ONLY):

Field adjust trip settings of motor starter magnetic-trip-only circuit breakers.

Adjust to approximately 11 times motor rated current in accordance with NEC 430-52.

Determine motor rated current from motor nameplate following installation.

OVERLOAD RELAY:

Select and install overload relay heaters after the actual nameplate full-load current rating of motor has been determined.

MOTOR DATA:

Provide typed, self-adhesive label attached outside each motor starter enclosure door displaying the following information with plastic black and white lettering, minimum 1/2-inch size:

Motor served by tag number and equipment name.

Nameplate horsepower.

Motor code letter.

Full load amperes.

Service factor.

Installed overload relay heater catalog number.

END OF SECTION 16480